ACORN USER

For the BBC micro, Atom and Econet users

December 1982 £1

Software review pullout

Procedures explained

Atom word processing

Hints and tips

BBC goes to school



TRON competition
for schools page 67



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ACORN USER Monthly

DECEMBER 1982, NUMBER FIVE



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You are welcome to submit articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written. Black and white photographs or transparencies are also appreciated. If submitting programs please send a cassette or disc. Listing should not contain more than 39 characters per line for ease of reproduction. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere. Send articles, reviews and information to: The Editor, *Acorn User*, 53 Bedford Square, London WC1B 3DZ.

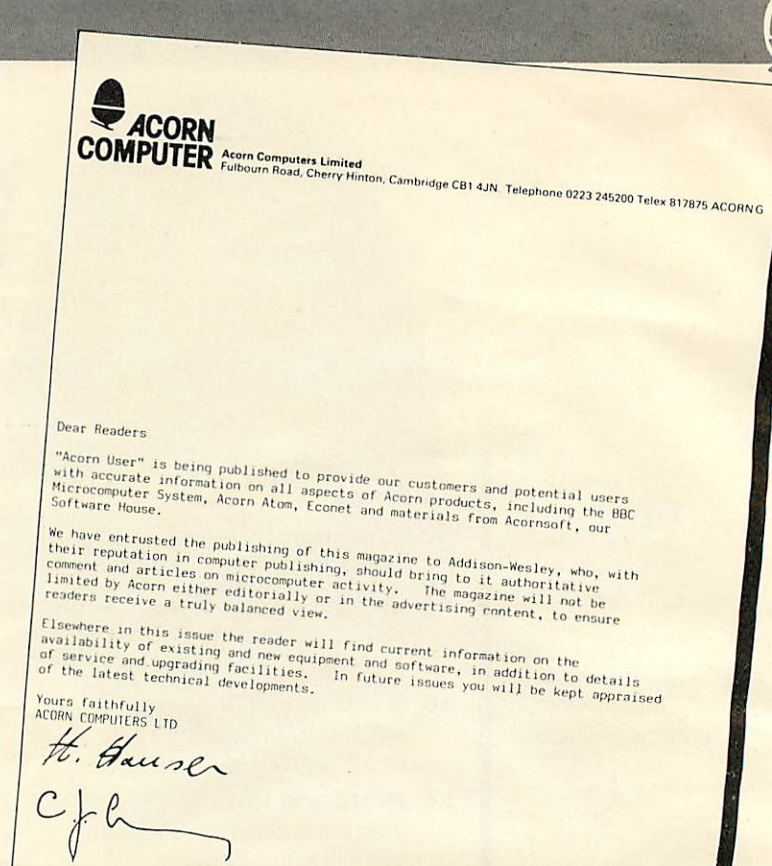
Coming soon in *Acorn User:*

● A to Z of Primary School computing – special pull-out section ● More on machine code ● Telford's hints and tips on using discs ● Games listings ● Atom utility boards reviewed ● Book reviews ● More software reviews ● Machine code printing ● Science programs for secondary schools ●

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Dear Readers

"Acorn User" is being published to provide our customers and potential users with accurate information on all aspects of Acorn products, including the BBC Microcomputer System, Acorn Atom, Econet and materials from Acornsoft, our Software House.

We have entrusted the publishing of this magazine to Addison-Wesley, who, with their reputation in computer publishing, should bring to it authoritative comment and articles on microcomputer activity. The magazine will not be limited by Acorn either editorially or in the advertising content, to ensure readers receive a truly balanced view.

Elsewhere in this issue the reader will find current information on the availability of existing and new equipment and software, in addition to details of service and upgrading facilities. In future issues you will be kept appraised of the latest technical developments.

Yours faithfully
ACORN COMPUTERS LTD

H. Hauser

C J Curry

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Joint Managing Directors

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TO THOSE of you who have never seen a copy of *Acorn User* before – welcome. You are reading the only magazine for users of the Atom, BBC microcomputers and Econet systems which has official support from Acorn Computers.

Acorn User is relatively new – it was launched in July – and this is the second issue to be distributed nationwide. Its role is to help you squeeze the best from your micro (and help you get one), as well as providing news of the latest developments from Acorn, the BBC and any other sources which are relevant.

The word 'users' is meant in its widest sense as readers come from all worlds – education, business, industry, home – and many countries. So whatever your interest, there should be something here, if not let us know.

This month we have included a special pullout section on software for the BBC micro. A wide range of software has been reviewed ranging from space and maze games to music and maths. We hope this will give you a taste of the wide range of software now available for the Beeb. There's something for everyone.

In this month's article from the BBC, David Allen describes how one primary school has reacted to the Beeb and some educational software. This school features in one of the programmes in the BBC's new series 'Making the most of the micro' which begins in January.

The BBC micro is one of the three machines which has been recommended by the government to primary schools and which is being subsidised by the Department of Industry. Acorn Computers are giving extra support to schools by fitting a free Econet interface to machines ordered by schools on the form being sent to all schools this month (see News).

Many primary schools will be getting their first micro in the next few weeks and *Acorn User* is providing guidance for these schools. This month, Heather Govier describes using the language Logo with children in Croydon (page 27). Next month we are starting a six part monthly pullout section for primary schools. The first pullout section in the January issue is especially for schools who have just received their first micro.

Especially for Atom users, we have a word processing program (page 46). This uses the Sinclair printer and so provides a simple word processing facility very cheaply.

It just remains for everyone at *Acorn User* to wish all our readers a very happy Christmas, and see you in the new year.

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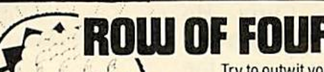
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"Programs for the people"



BBC and schools get together

BRIGHTON Polytechnic and the BBC are joining forces from January to run the Telesoftware and Primary Education Project. The thirty primary schools involved in this three year project are spread over Hampshire, Wiltshire, Sussex, Kent, Leicester and Sheffield. The BBC are providing CEEFAX transmissions free of charge and schools will be downloading software using the BBC micro with teletext receiver.

The programs being transmitted will include stand alone programs on such things as putting words into a sentence and simple sums, programs to go alongside educational TV broadcasts and programs using information on teletext as a database. The project begins in January with programs to stand alongside the TV series 'Maths Score'.

The project director, Dr Martin White, explained that the most exciting feature of this project is that 'some of the programs will interrogate live CEEFAX signals, so schools will be able to use up to date data without having to key it in'.



Atom future assured

ATOM users may have been wondering where their machine fits into Acorn's plans with the prospect of the launch of Acorns newest machine, the Electron, shortly.

Any fears for the future support of their machine were dispelled by Acorn Director, Chris Curry. He said, 'We are going to continue producing the Atom, but at a reduced rate. Acornsoft will continue to provide software. The marketing direction will change towards electronics hobbyists with advertising in *Practical Electronics* and *Practical Wireless*'. It looks as though Acorn see their future Atom users as electronics enthusiasts rather than the general hobbyist.

Free Econet for schools

ACORN are offering free Econet interfaces for model Bs ordered by schools under the Department of Industry scheme. The scheme covers any number of machines ordered up to the end of 1984. But schools must order their micros on the special order form that is being sent to schools with the Tron package (see pages 67 and 68). Acorn are giving financial backing to their belief that 'Econet and schools go hand in hand'.

Beeb sales top 50,000

DELIVERIES of the BBC micro have now topped the 50,000 mark. Acorn are delighted to report that delivery problems on both models A and B have now been solved. Stocks are now available of both models for immediate delivery.

Acorn UK dealer list see page 75

Toothless BBC Watchdog

VIEWERS of Nationwide's Watchdog will have been disappointed with the feeble investigation of the BBC by this usually thorough program.

Watchdog were investigating a spate of complaints about the BBC in connection with late deliveries of the BBC micro. One customer, Tom Van Den Linden said he had sent his cheque to the BBC for a BBC micro seven months ago and had only just received his computer.

Sales Manager for BBC Enterprises, Roy Gibbs, passed the buck by saying that there had been three problem areas delaying the delivery of the micro, all outside the BBC. He said that these three problems were a delay in the technical development at Ferranti, demand which was five times higher than expected and marketing problems as the first firm doing this job had no experience of handling computers. When asked who was to blame for the delay, was it the BBC, Acorn or the marketing firm, he hedged and said that the BBC took total responsibility to ensure that a customer gets what he is paying for. He went on to say that the BBC were the commissioners of the project, Acorn had created the micros and another firm had undertaken the marketing and distribution. He said the BBC's involvement with Acorn was total and that there were far fewer complaints now.

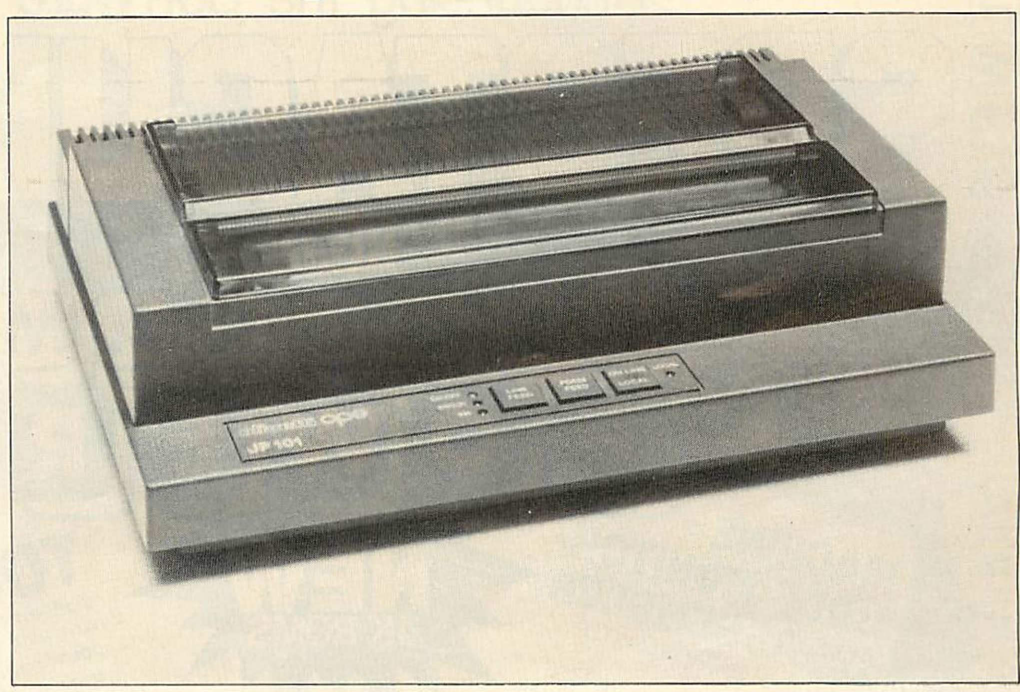
When asked to comment on the programme, Peter Goater formerly of BL Marketing and now of Vector Marketing, the company which now markets the BBC micro commented that 'No doubt, we have had problems. But the situation now is that things are really settling down and working a lot more smoothly. Both models are now in stock for immediate delivery.'

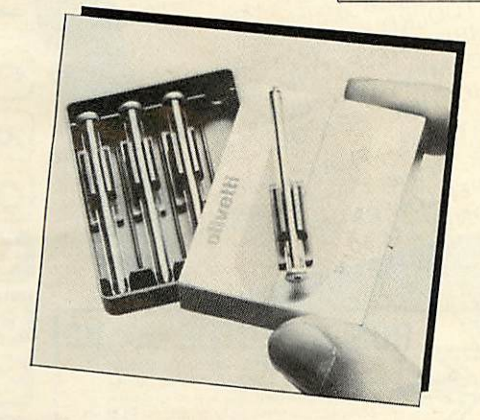
Acorn Director, Chris Curry, commented that 'It was sad that Watchdog didn't say we'd delivered 50,000 units. They didn't tell people that the problems had been overcome and no-one was waiting any longer.'

It wasn't all bad news from Watchdog. The reporter ended the investigation with a quote from the Observer to say that the BBC micro is 'a humdinger of a design'.

Acorn marketing Olivetti's printer

ACORN have exclusive marketing rights on the new Olivetti dry ink jet printer which is now available from Acorn Dealers for £360 (including VAT). Acorn Director, Chris Curry said it has much higher resolution. than any other printer for the price. It has such high resolution that the number of dots per cell can be altered. This means that it can print a grey scale and so can print initiation colour using different shades of grey to correspond to colours. It is also quiet, light weight, and fast and connects to any computer with a centronics interface.

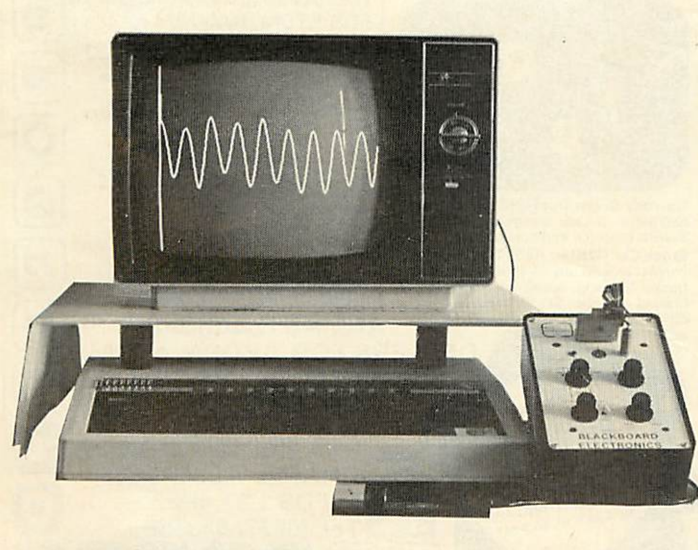




Acornsoft Educational software

ACORNSOFT are going into the educational software market with the publication of five packages, costing £11.90 (including VAT) each. The software has been written by a husband and wife team, Ann and Russel Wills. Ann is Head Teacher of a primary school in Scotland and Russel is a Lecturer in Computer Education at Dundee. The five packages are all for primary schools. They cover basic maths and English skills and are called Word Hunt, Missing Signs, Maths Balance, Word Sequencing, Sentence Sequencing.

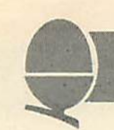
Interfaces for schools



THE combination of a teacher, an ex-teacher and an electronics engineer has lead to the function of Blackboard Electronics of Stockport, who are designing and producing computer interfaces for the educational market.

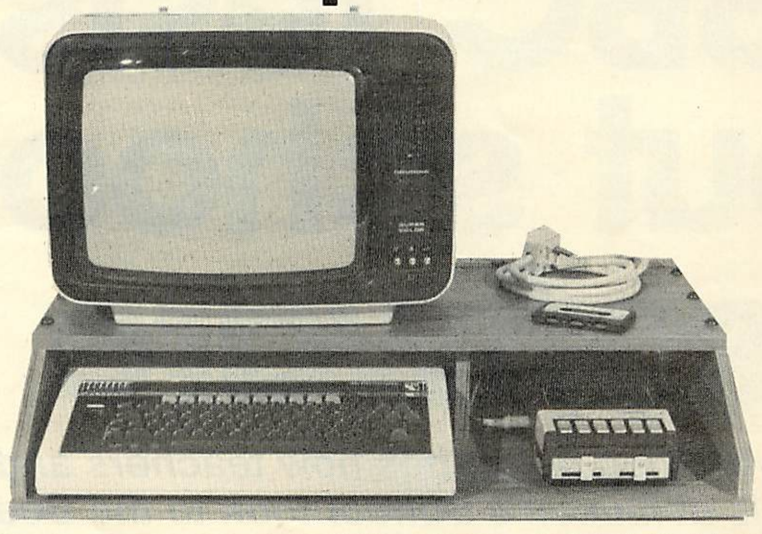
Their *Analogue Digital Converter* (£45) for the Atom and BBC micro provides a storage oscilloscope, a pH probe monitor, plasmagraph and digital volt-ohm meter. Their *Power Interface* (£55) for the Atom and BBC micro allows the computer to control eight outputs, each of which may operate motors, relays, lights etc. The eight channels can also be programmed to act as inputs. A *Superfast A/D Converter* will also be available shortly, which will be able to cope with radio frequencies.


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Tidy up your computer room

A practical and tidy installation for the BBC micro and its peripherals has just been announced by Standard Video Ltd of Chesterfield. Called a Microboard Workstation and costing £29 it allows you to stand your TV or monitor directly over your micro. All connecting wires can be stowed neatly out of sight and a special ventilation aperture is provided in the base. This should certainly save space and help to keep things tidy in the computer room.



Throwing light on the Beeb

R H ELECTRONICS Ltd of Cambridge will be launching their light pen for the BBC micro later this month. The price is £30 (including VAT, postage and packing) and it comes complete with a cassette which demonstrates how it works. The light pen can be used to draw direct onto a TV screen and you can draw squares, triangles, circles and curves.

More sophisticated software is planned for early next year which will make the light pen of interest to professional draughtsmen. Games software is also planned to take advantage of the light pen's facilities.

Beeb launch in U.S.

ACORN are planning to enter the US next year with the BBC machine. This will have to meet the U.S. colour standards which means that a fundamental timing change will have to be made for the VDU interface.

The American company will be known as Acorn Computers Inc and is registered in New Hampshire.

Machine Operating System on the Beeb

A new operating system, known as Series 1, will shortly become available. This will allow paged ROM support for additional system services and languages, two-way data transfer through the RS423 interface and improved operation of the cassette filing system.

The new MOS will be fitted automatically by Acorn Dealers when installing upgrades for Disc, Econet, Teletext, Secondary Processors or new language ROMs.

If a peripheral or language upgrade is not being purchased, dealers will install the new MOS for £10 plus VAT. For early purchasers, whose machines contain the EPROM version, no charge will be made in exchange for the EPROMs.

Acorn matches Sinclair's offer

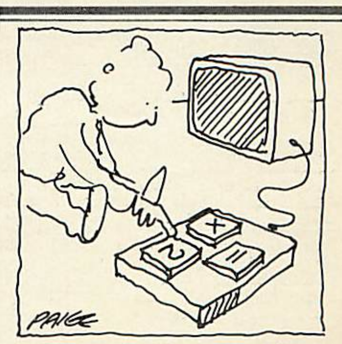
ACORN'S free Econet offer to schools more than matches Clive Sinclair's free printer offer to primary schools buying a Spectrum.

Clive claims that his offer is worth up to £15million. The absurdity of the Sinclair offer becomes obvious when you work out how he has reached this figure. He assumes that all 27,000 primary schools buy eleven Spectrums, so claiming eleven printers at £50 each (11 x 27,000 x £50 = £14.9 million.) Acorn's offer is worth £47 on each machine and is likely to prove much more useful to schools in the long run.

Word processor in ROM

A new word processing package for the Beeb in a 16K ROM costing £59.80 including VAT) has just been announced by Acornsoft. It is called *View* and comes complete with teaching and reference manuals and can be used with either cassette or disc.

The package makes use of the special features of the BBC machine – all editing is done using the function keys.



Sinclair Mathematics



BBC tests out school software

David Allen describes how teachers and pupils at Queen's School took to the Beeb

In the second programme of the follow up series to The Computer Programme, which we're calling 'Making the Most of the Micro', we will be showing how all computer programs are made up of only three programming structures – the sequence, the decision branch and the loop. To do this we've taken an 'everyday' situation – it's a class of ten year olds in a primary school in West London being tested on their maths – and we're mimicking what the teacher does with the class in a simple computer program. It may well be simple, but it does contain the crucial basics of programming, explained, perhaps, in a new way. It also shows some of the strengths of BBC Basic since the use of REPEAT . . . .UNTIL and ELSE make the structure of the program much easier to see than in more primitive BASIC.

Although the main theme of the television programme – it's called 'Getting Down to BASIC' – is, of course, programming, a parallel theme is that of computers and children. Over half of those owners of BBC micros who were asked by our Audience Research Department why they had bought their machines said it was to 'help their children with their education'.

So, since we were interested in how the micro could be used with children – for example in the classroom – and in how those new to computers react to them, where better to look than in that same West London school? The school duly received a Model B and some software from us. Initially we gave them the WELCOME Pack and then, over a few months, a variety of programs which we thought might appeal to them for use in the classroom.

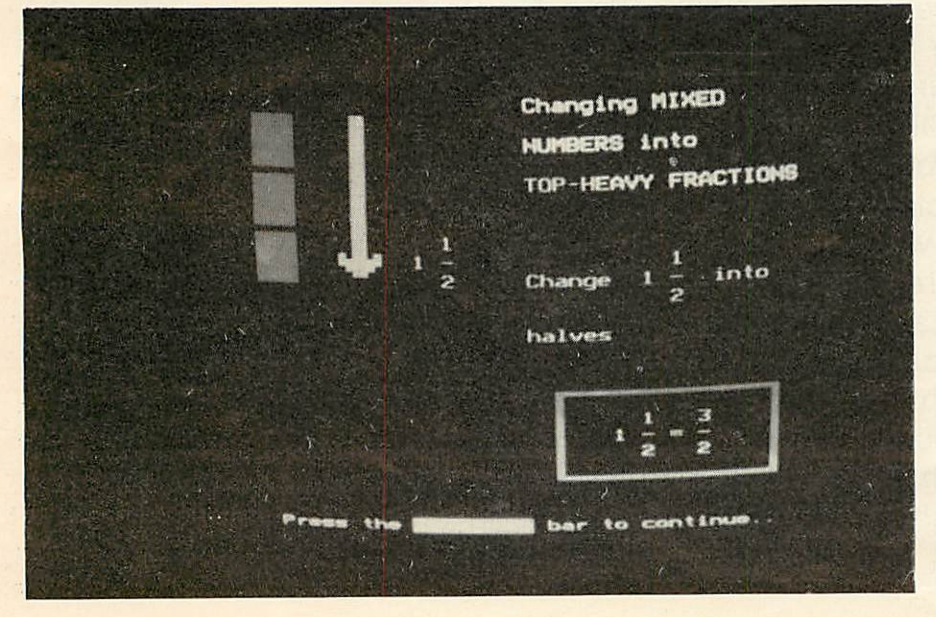
The initial reactions of the staff were very mixed. Jenny Capstick said 'Oh help!' when confronted with the machine for the first time. They clearly had a very ambivalent attitude to the whole idea of the computer, and admitted to a range of emotions – panic, fear, fascination: 'I felt excitement and trepidation' said Malcolm Rivers, (our victim in the maths film sequence). 'You don't want to appear ignorant, yet you know that computers are here and that there is an educational bandwaggon rolling and somehow you ought to be on it'.

Few of the staff were expert typists and so they found the KEYBOARD program in the WELCOME Pack particularly useful. Some, like Malcolm and the headmaster, Mike Warden – were intrigued enough to take the machine home during the school holidays.

It is now almost a cliche that children take to the microcomputer more quickly and with less inhibition than adults. It was certainly true at Queen's School. The machine soon left the shelter of the staff room and became the centre of attention in a number of classrooms, with teachers using it, for small group work, on a kind of informal rota.

Everyone expected the machine to have a curiosity and play value, but, once that initial scurry of interest died down, we wanted to see which programs the staff would find useful in their normal work. A few weeks ago we returned to the school to film some of the software being used.

Yellow River Kingdom from the WELCOME Pack was used a great deal. Anyone who has played it knows that it is a simulation representing a little kingdom over which you have control. The river floods, thieves raid the villages and other disasters loom. As leader you have to survive as long as possible, dividing your workforce between



working in the fields, looking after the dyke and defending the place – and especially the rice – from attack.

At least one class teacher found that it fits in well with the overall theme of 'treasure' which is one of the topics for the term. They are treating the rice as the treasure, to be protected at all costs. However, a number of the children have begun to suspicious of the internal 'logic' of the program – a reaction which must be healthy, since so much software, especially that which does calculation, is accepted without question my most users.

The MEP (the Microelectronics in Education Programme, sponsored by the Department of Education and Science) has supplied the BBC with a number of excellent pieces of software in preparation for our Telesoftware Service beginning early in 1983). They are robust, well presented programs written to a high standard. We made some of these programs available to the school and a number of them proved extremely popular. We filmed two in use: BRICKUP, which is a spelling game and CRASH, which enables you to program a moving pointer through a maze to reach a target.

BRICKUP tests vocabulary and spelling. The program presents you with the defintion of a word and gives you the first two letters. If you successfully spell the word, a small gun appears and you can have a shot at the brick wall which is between you and freedom. If you fail, the wall increases in size and you are likely to get bricked up. Of course, such a program has to be used with care – too many failures could frustrate the poor speller.

CRASH is especially interesting in that it enables the children to program the machine themselves, using a simple language. You enter a sequence of lettes – L or R for a 45 degree turn to left or right and F for forward. On pressing RETURN the pointer moves in the path you have given it; going on to reach, or fail to reach, the target. And at the same time a small arrow points out where you are in the program so that mistakes can be rectified. CRASH is a kind of precursor of LOGO, the language developed by Seymour Pappert which is soon to be available for the BBC machine. (see pages 27–31)

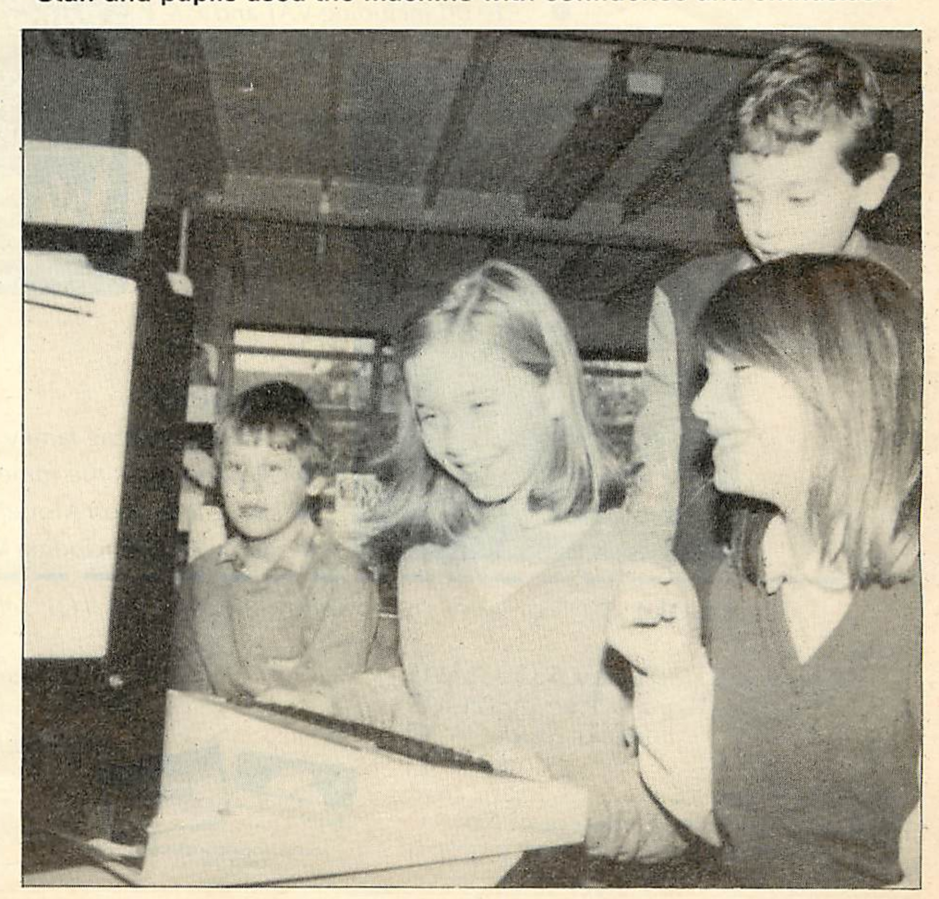
Overall, most impressions were favourable. The fear had gone and most staff were using the machine with confidence and enthusiasm. It was interesting how many children thought it was all a game – 'Something', in the words of one girl, 'to get you off work'. It must be admitted that most of this software did consist of games. Yet the old pre-school saying, 'Play is a child's work' should apply here. All the programs can be defended in that they reinforce skills of different kinds. Of BRICKUP the same girl went on to say, 'You come across a word during your ordinary work and you think "I know how to spell that from the game."'

It has to be said, ours was not a scientific experiment to prove whether the computer has any profound educational value in the classroom. Like all educational tools it can be used well or badly, imaginatively or unimaginatively and, of course it's not a substiturte for the teacher. We're also well aware of the 'Hawthorne' effect – which, roughly speaking, in this context means that because we were coming back to film the software being used, the staff had a special incentive to make sure it was being used and, maybe even felt they had to say nice things about it. But we know them well now, and certainly they have reservations. Malcolm Rivers again: 'I've mixed reactions – you're obviously depending on the structure of the program and the program is structured to someone else's ideas. Those ideas may or may not coincide with yours'.

Of course, these are early days in the mass use of the computer across the curriculum in schools like Queen's. The standard of software is improving and that includes the quality of the ideas behind it, not just the quality of the programming and the presentation. But it will be a few years before we have a real chance to assess the educational worth of the technology we have helped to unleash.

Meanwhile, why not watch the series – it starts in January 1983 on Sunday nights, and the Queen's School features in Program 2.

Staff and pupils used the machine with confidence and enthusiasm



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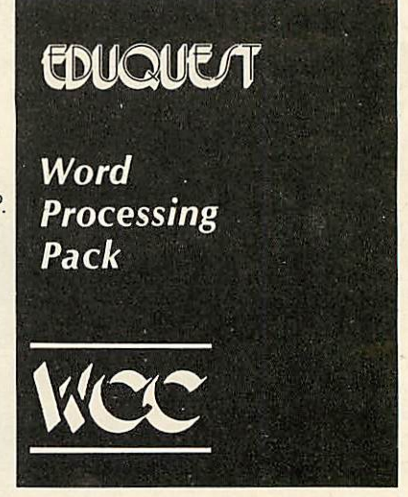
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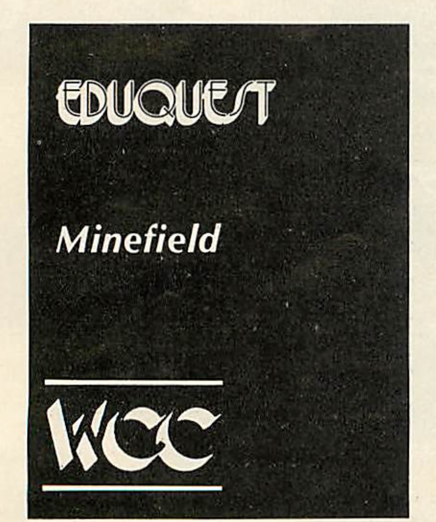
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REGISTERS EXPLAINED

Busses, registers and addressing modes are all explained by John Ferguson and Tony Shaw in this article on assembly language programming on the Beeb

The 6502A microprocessor lies at the heart of the BBC micro and communicates with other chips through groups of wires or tracks called busses (figure 1). On the address bus, the processor sets up a voltage pattern that acts like a key unlocking the door to some location within the micro, such as a memory location or an interface chip.

The microprocessor can either transmit information to the location (a WRITE or STORE operation) or receive data from the location (a READ or LOAD operation). Once power is on, the microprocessor is busy reading numbers from memory locations, interpreting instructions and carrying out the operations defined by them. To help with this, the microprocessor contains some special memory locations called registers. These do not form part of the memory map (*User Guide*, page 500) and are identified by name rather than number (figure 2).

The accumulator 'A' is the main working register and takes part in most of the mathematical and logical operations performed by the processor. The X and Y registers are used to store values for counting and timing, or as variable pointers for use with lists and tables. The program counter (PC) contains the address of the next instruction and the stack pointer holds the position the processor has reached in its temporary note pad – the STACK. Finally, the processor status register P contains a collection of bits or 'flags' that are set or cleared depending on the outcome of the previous instruction (figure 3).

Several program statements can be used to place a number in a processor register. Here are some examples using the accumulator, similar instructions exist for the X and Y registers (figure 4):

In the first example the processor is instructed to place the hexadecimal number &41 in the accumulator, whereas in the second the accumulator is loaded with the contents of memory location &1600. Example three is similar – loading A with the contents of 'zero page' memory location &0080. (All memory locations whose address begins with two zeros lie in zero page. When referring to those locations the first two zeros can be omitted eg &0080 becomes &80.) The final example illustrates how the accumulator can be loaded by transferring data from another register, in this case the X register.

These methods used by the processor to find data are called addressing modes. In the first example the hash '#' symbol defines immediate addressing; in example 2 the full 16-bit address leads to absolute addressing; the shorter form, in the third example is called zero page

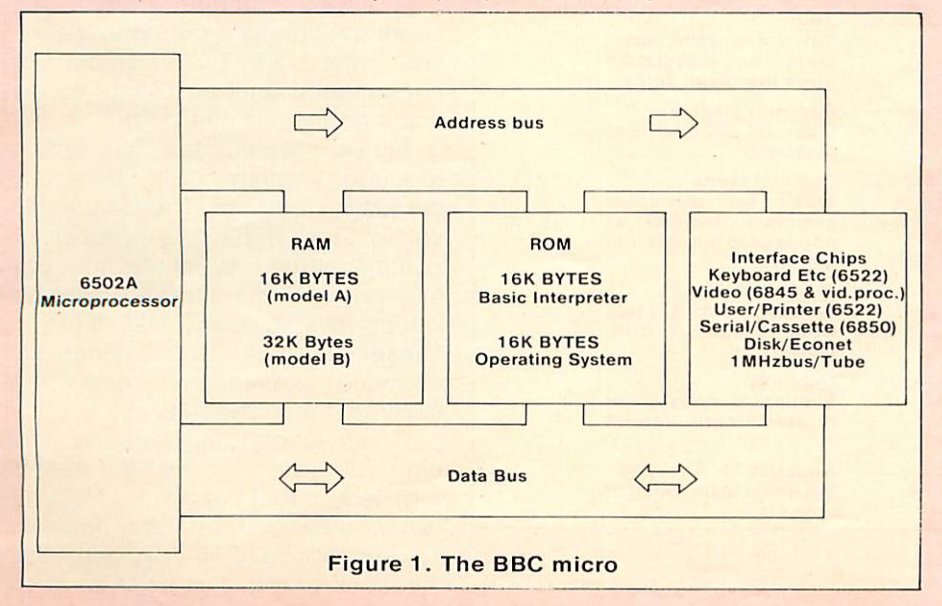


Figure 1. The BBC micro

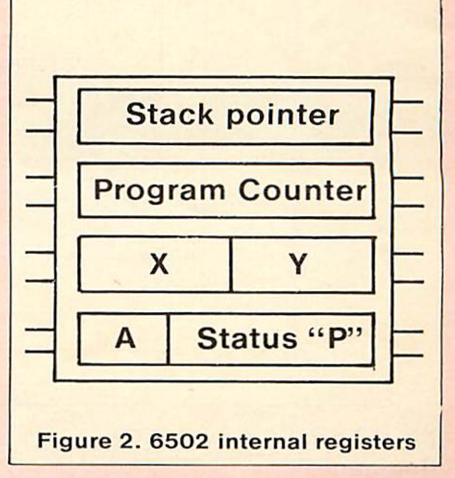


Figure 2. 6502 internal registers



```
   10 REM PLAYING WITH REGISTERS
   20 P%=&1500
   30 [
   40.START LDY #&41 \IMMEDIATE ADDRESSING
   50       STY &80 \ZERO PAGE ADDRESSING
   60       LDA &80 \ZERO PAGE ADDRESSING
   70       TAX     \IMPLIED ADDRESSING
   80       STX &7C10 \ABSOLUTE ADDRESSING
   90       RTS     \BACK TO BASIC
  100]
  110 MODE7
  120 CALL START
>RUN
1500
1500 A0 41    .START LDY #&41 \IMMEDIATE ADDRESSING
1502 84 80    STY &80 \ZERO PAGE ADDRESSING
1504 A5 80    LDA &80 \ZERO PAGE ADDRESSING
1506 AA       TAX     \IMPLIED ADDRESSING
1507 8E 10 7C STX &7C10 \ABSOLUTE ADDRESSING
150A 60       RTS     \BACK TO BASIC
```

Program 1. Use of registers and addressing modes (for model A, screen = &3C10)

```
 10 REM INCREMENT INSTRUCTIONS
 20 SCREEN=&7C10
 30 P%=1500
 40[
 50.START LDX #ASC("A")\ASCII A INTO X
 60       STX SCREEN\ONTO SCREEN
 70       INX  \NEXT X IE ASCII "B"
 80       STX SCREEN+1\INTO NEXT LOCATION
 90       RTS\BACK TO BASIC
100]
110 MODE7
120 CALL START
130 END
```

Program 2. Using an increment instruction (for model A, screen = &3C10)

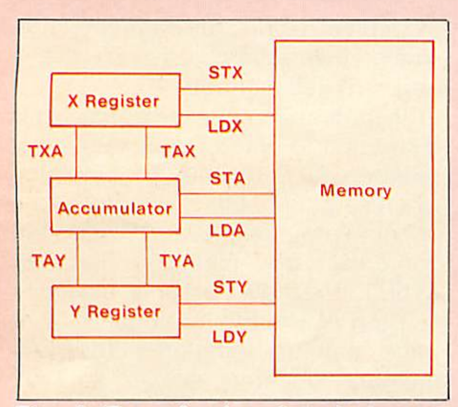


Fig. 4. Transferring data between A,X, Y and memory (see p. 508 *User Guide*)

addressing; and finally the transfer instruction, TXA, is an example of implied addressing where the instruction mnemonic itself defines where the data is found.

Program 1 illustrates each of the addressing modes, passing the ASCII code for the letter 'A' between registers and memory before eventually placing it on the screen.

As a result of being closely connected to Basic, the BBC assembler allows you to carry Basic functions into an assembly language program. For example, line 50 in the previous program could be written as:

50. START LDY ASC("A")

or if you want to:

50. START LDY (16+INT(100*SIN(PI/6)))

Both statements, believe it or not, will yield the hex value &41 after assembly.

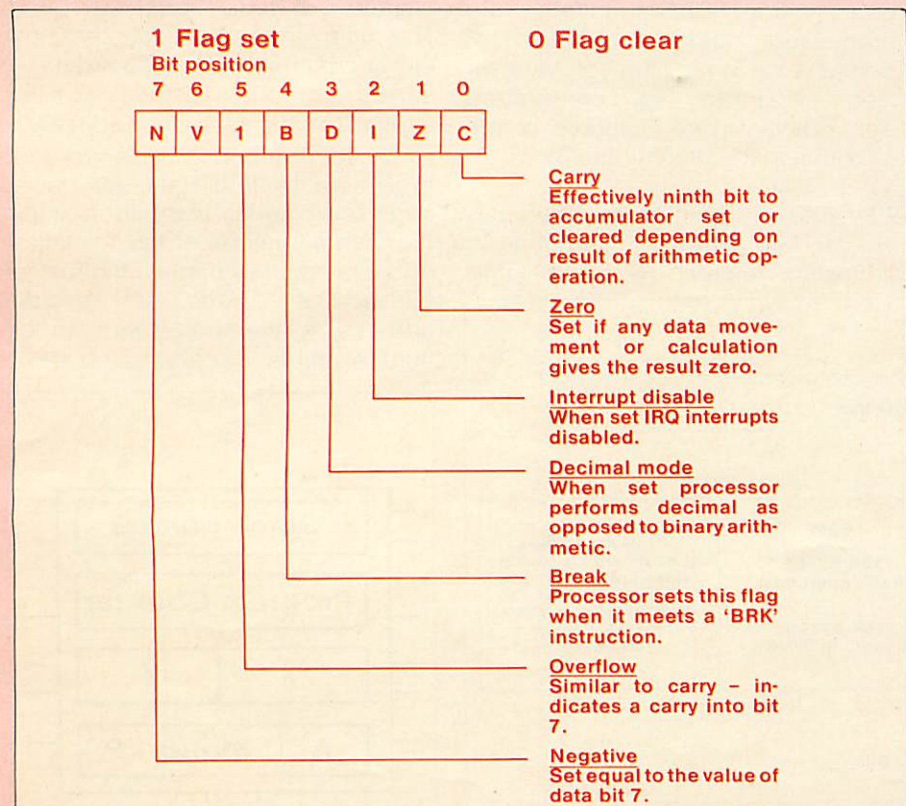


Figure 3. The Processor Status Register 'P'

A common requirement, within a program is to repeatedly increment a value by one. For example, we may need to keep a count of the number of times a section of program is executed. In Basic this can be achieved by an assignment statement of the form C = C + 1, where C is the variable used to count the number of operations performed. Another method of counting in Basic is to use the FOR . . . NEXT structure. That is, the count variable is incremented each time the NEXT statement is encountered until such time as the final condition is met.

Similar techniques are often required within an assembly language program. The instruction set of the 6502 microprocessor contains three instructions specifically for incrementing an existing value – INC, INX and INY (table 1). These perform the necessary counting operations and are illustrated in program 2.

A limitation imposed by the eight-bit size of the X and Y registers is that each will only hold values between 0 and 255 decimal. To go above 255 decimal, two locations or registers must be used

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Table 1. Increment instructions (program 1)

INC abcd	increments the contents of the specified memory location
INX	increments the contents of the X register
INY	increments the contents of the Y register

to provide a total of 2 x 8 bits = 16 bits. (The maximum will then be 65535 decimal.) Lack of a 16-bit counter is a common weakness of eight-bit microprocessors. Another weakness is its inability to directly increment the accumulator contents – a feature present in most microprocessors through an instruction of the type INC A.

As well as counting up within a program the ability to count down is useful. The 6502 microprocessor includes three decrement instructions that complement the increment instructions, (table 2).

Table 2. Decrement instructions

DEC abcd	decrements the contents of the specified memory location
DEX	decrements the contents of the X register
DEY	decrements the contents of the Y register

In the previous programs assembly language statements were used to load the processor's registers. Alternatively, registers can be loaded by Basic on entering a machine code routine.

BBC Basic includes the resident integer variables A%, X%, Y% and C% that may be manipulated within a Basic program, but whenever a machine code routine is CALLed, the current values of these variables are placed in the corresponding registers of the microprocessor. Program 3 illustrates this technique.

Since A, X and Y are eight-bit registers, only the low bytes (least significant eight bits) of the variables A%, X% and Y% are passed to the microprocessor's registers. The carry flag occupies only one bit of the processor status register so only the least significant bit of C% is passed.

The USR function, like CALL, provides the facility to call machine code programs. Similarly when USR is executed the current values of A%, X% Y% and C% are transferred to the appropriate microprocessor registers. However, USR has the advantage over CALL in that the register information at the end of the machine code progam can be easily returned to the Basic program. The register values are not automatically placed into A%, X%, Y% and C% but are combined into a single integer variable the name of which is supplied by the user. For example the two statements:

CALL &1500 and
R = USR (&1500)

call the machine code routine at $1500. Both will transfer the contents of A%, X%, Y%, and C% to the A, X, Y and P registers. However, in the above example CALL will not pass any register information back to Basic from the machine code routine whereas USR forms the integer value R from the combined values of P, Y, X and A. For example if:

P = 01011101, Y= 11000011, X = 00000000 and A = 00000001

then on return R will be:

```
R = 01011101 11000011 00000000 00000001
       P        Y        X        A
```

These register values can then be obtained for use within the Basic program.

Program 4 illustrates how register values can be passed to a machine code program via A%, X% and Y%. Change puts 5 into the accumulator, adds 3 to the X register and adds 2 to the Y register. The USR function returns the changed register values in R and the new values can be seen when R is printed:

Y = 04, X = 09 and A= 05

(The ~ prefix in line 330 is used to print R in hex format.)

When judged on ability to transfer register contents it may appear that USR is more useful than CALL. However, we will see later that CALL is the more powerful instruction with the ability to pass more information between Basic and machine code programs.

```
10 REM SETTING UP A,X AND Y FROM BASIC
20 REM ASSEMBLE MACHINE CODE PROGRAM
30 SCREEN=&7C10
40 P%=&1500
50[
60.START STA SCREEN\PLACE CONTENTS OF A ON THE SCREEN
70       STX SCREEN+1\PLACE CONTENTS OF X IN NEXT LOCATION
80       STY SCREEN+2\PLACE CONTENTS OF Y IN NEXT LOCATION
90        RTS\BACK TO BASIC
100]
110 REM GIVE VALUES TO A%,X% AND Y%
120 A%=&41:X%=&42:Y%=&43
130 REM CALL MACHINE CODE ROUTINE AND PASS REGISTER VALUES
140 MODE 7
150 CALL START
160 END
```

Program 3. CALL used to pass register values

```
100 REM PROGRAM TO CHANGE REGISTER VALUES
110 P%=&1500
120 [
130 .CHANGE LDA #5  \SET A TO 5
140  INX            \ADD 3 TO X REG
150  INX
160  INX
170  INY            \ADD 2 TO Y REG
180  INY
190  RTS            \RETURN TO BASIC
200 ]
210 REM
300 REM PASSING REGISTER VALUES WITH USR
310 A%=0:X%=6:Y%=2
320 R=USR(CHANGE)
330 PRINT ~R
340 END
```

Program 4. USR passes register values


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Conducted by Ian Birnbaum

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This column is also here to solve programming problems. Ian cannot answer letters personally, but will endeavour to include a cross-section of the most interesting and commonly-occuring issues.

Packing the bytes to save on memory

WHEN using high-resolution graphics memory can be at a premium. But the micro provides an easy way to save spaces. Let's look at an example.

Suppose you want to save 1000 pairs of numbers, each number being either 1, 2, 3 or 4. The most natural way to do this is by assigning them to two integer arrays thus:

```
DIM X%(1000),Y%(1000)
```

so pair one is X%(1),Y%(1); pair two is X%(2),Y%(2); and so on. Though this is simple it wastes a considerable amount of memory: we have used up over 8000 bytes to store these 1000 pairs, since each number occupies four bytes.

A more efficient way to store these numbers is to use the BBC's facility for byte allocation. If we write

```
DIM BASEX% 999,BASEY% 999
```

we reserve 1000 bytes, the lowest address of which is BASEX% (1000 not 999, because the interpreter counts from zero). To simplify access we now write

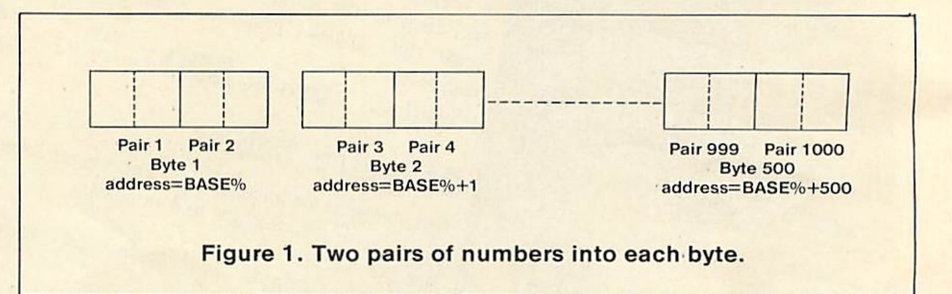


Figure 1. Two pairs of numbers into each byte.

```
30A%=BASE%?((I%-1)DIV2):Z%=X%+4*Y%-5
:REM Diminish X% and Y% by 1 and pack
into 4-bit format
40IF I%MOD2=1 THEN BASE%?((I%-1)DIV2
)=(A%AND240)ORZ% ELSE BASE%?((I%-1)DIV2
)=(A%AND15)OR(16*Z%):REM Either put
lower 4 bits to zero and replace by Z%,
or ditto with higher 4 bits
```

Program 1. Assigns a number to each pair.

```
50A%=BASE%?((I%-1)DIV2)
60IF I%MOD2=1 THEN A%=A%MOD16 ELSE A
%=A%DIV16:REM Pick up lower or upper 4
bits
70X%=(A%MOD4)+1:Y%=(A%DIV4)+1:REM
Separate bottom 2 bits from top 2 bits
```

Program 2. Reads each pair.

```
BASEX%=BASEX%-1:BASEY%=
BASEY%-1
```

To assign a number to the Ith pair we can write

```
BASEX%?I%=X%:BASEY%?I%=Y%
```

where BASEX%?I% is another way of writing ?(BASEX%+I%); and to read the value of a pair we write:

```
X%=BASEX%?I%:Y%=BASEY%?I%
```

using this method we have cut our memory usage to just over 2000 bytes.

But we can do better than this! Each byte can hold any number from 0 to 255, yet we only require it to hold from 1 to 4. Two bits are enough to do this: 00, 01, 10 and 11. Since a byte consists of eight bits, we can pack two pairs into a byte (figure 1). Inevitably, accessing the pairs is more complicated (and a little slower), but the memory saving is considerable. We begin with:

```
DIM BASE 499
```

which reserves 500 bytes. To assign a number to the Ith pair we use progam 1, and to read a pair we use program 2. You may have to study these carefully to see how they work. But even if you can't completely follow them, the memory saving is still available to you. We now need just over 500 bytes, less than 1/16 of the original allocation.

Of course, if your numbers are beyond the one to four range you will need more bts : one to 16 can be accommodated in half a byte (a nibble!), and one to 256 is a full byte. To simplify the accessing of the information it is best to work in units of 1, 2, 4 or 8 bits.

Byte packing is well worth remembering next time you need to save memory.

How to pass a global variable

THE *User Manual* implies that variables must start with a letter, either capital or small, but this is not strictly true. You can also start variables with the £ symbol or the underscore symbol (found on the same key as £). Information on these is found at &4C0 and at &4BE in the variable table.

The great advantage of this is that you can use variables starting with £ and _ as global variables in procedures. Dr R. Harding does this with £ in his Acornsoft book.

The point here is that if we require to return values from a procedure, we have to use a variable which will retain its value outside the procedure. Clearly we cannot use local variables, and these include the parameters we pass to the procedure. One advantage of procedures is that we can create a library of them and attach those we need to a program. By using local variables we ensure that there is no incompatibility with variable names in the main program. But with global variables this can happen.

However, if we agree never to use variables starting with £ and _ in our programs (not a restrictive convention after all) then we can use such variables as our globals. The most efficient way to do this in a library procedure is to have a REM statement with the names and functions of the global variables. On returning from the procedure, it is then easy to put one's own variables equal in value to the procedure's globals.

For example, a procedure to round a number to M% significant figures and to N% decimal places needs to return the rounded numbers. The first three lines of the procedure might begin:

```
DEF PROC_ROUND(N,M%,N%)
:LOCAL X%,Y%,X
REM Rounds N to M% sig figs and
to N% decimal places
REM _SIG and _DEC contain
the rounded results
```

This can be fitted into any program.

Create a library of procedures for future use

Notice the procedure name also begins with _: this is to ensure that no conflict can occur between the library procedure and any procedure specific to the main program. Conceivably, we might have used the name PROCROUND already, for example.

Whether you use £ or _ is up to you, but it is best to be consistent. The disadvantage of £ is that its ASCII value (96) is usually printed out on a printer as ‘. The disadvantage of _ is that in mode 7 it looks like a minus sign: but it prints out as an underscore on a printer.

Finding the lost program

YOU press BREAK, and type what you think is O.: you then LIST and are horrified to see line zero come up with a dot in it. And that's all you've got! It happened to me when I hadn't even saved the program, so I had to find a way of getting my program back.

Typing in program 3 as a direct set of instructions does the trick. Now LIST; and the first few characters have been lost, but your program is otherwise intact.

To understand how this works we need to understand how Basic programs are stored. Suppose you have a two line program:

```
10P."EXAMPLE"
20END
```

This is stored in memory as:

```
0D 00 0A 0E F1 22 45 58 41
               P.  "  E  X  A
4D 50 4C 45 22 0D 00
M  P  L  E  "
14 05 E0 0D FF
      END
```

Every line begins with 0D (carriage return). Then follow two bytes for the line number

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(here 000A and 0014). Then there is a byte giving the number of bytes in the line; and finally the text in the line. The very last line ends with a 'dummy line'. This is a line, the high byte of whose line number is &FF (or indeed any byte greater than &7F – this is why the maximum line number is 32767). In this example, since we have a two line program, the dummy line follows line 20.

When BREAK is pressed, the first two bytes read 0D FF, so only a dummy line exists. However, the rest of the bytes remain intact. The effect of O. is to replace the FF by 00, thus restoring the program. However, typing O. produces

```
0D 00 00 05 2E 0D FF
```

instead, thus overwriting the first seven or so bytes of your original program.

The way to retrieve your program is to find the end of the original line of your program (line 10 in our example):I% gives this, starting at zero and counting from the byte after line 0's FF (which is TOP-1 of line 0). Thus I%+2+ (contents of byte three, here 05) gives the correct length of the first line: this therefore replaces byte three. In fact this would be enough, but to tidy things up we replace by spaces line 0's 0D and FF. We should also replace the byte following line 0's FF by a space, since the interpreter puts the low byte of the lowest number of the old program here (which in our example is 0A). We use this fact to restore the correct line number first.

It should be clear how the one-line fix works now. It will remove the effect of either O. or OLD automatically. But you will have to correct the first line yourself, replacing the missing text by the appropriate coding.

The easy route to speedy procedures

YOU are using lots of procedures and functions in a program, but it is crucial that one of them is accessed as fast as possible. How can you ensure this?

The answer with subroutines would be straightforward – give the crucial one the lowest line number possible. However, the line numbers of procedures and functions are irrelevant to the speed with which they are accessed. Moreover, and this is more surprising, the order in which they are placed in the program has no bearing on speed of access.

We need to know how procedures and functions are stored

What is relevant is the order in which they are *met* in the program.

To understand this, we need to know a little about how the interpreter stores procedures and functions. The situation is similar to the storage of string variables (see last month's column for details), in that the address of information about the first procedure/function is put in a fixed position in memory. For procedures it is at &4F6 and for functions at &4F8. This contains the address of the area of memory which holds the full name of the procedure/function and the address in the program where it is defined; this area of memory also holds the address of the next area of memory where procedure/function information is stored. The area of memory with all this information is called the procedure/function information block (PIB or FIB).

Hence the PIB for PROCTEST might be

```
44 20 54 45 53 54 00 A4 19
```

The first two bytes give the address of the next PIB (at &2044); then comes the name, terminated by the zero byte; and then the address of the definition of PROCTEST in the program (at &19A4).

Thus what happens when the interpreter comes to a PROC, say PROCNEW, in a program is that it goes to the address pointed to by &4F6. If &4F6 and &4F7 contain zeros, the interpreter knows this is the first procedure it has met, and information on where it is defined is put in memory. &4F6 now points to this first PIB.

If, on the other hand, &4F6 already contains an address, then the interpreter skips through the PIBs until it finds the PIB relating to PROCNEW. If it doesn't find it, it

For fast access your procedure must be the first in the program

sets up a PIB (or gives a no such FN/PROC error). The situation is identical for functions, except that it begins at &4FB and skips through FIBs rather than PIBs.

It follows that if speed of access of a procedure is crucial, you should arrange that the relevant procedure is the first to be met of all the procedures in the program; and similarly for functions. This may require a 'dummy' call early on in the program.

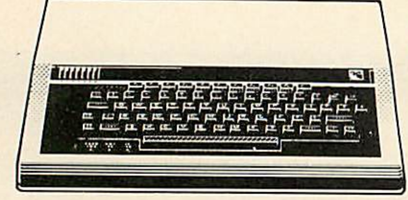
Note, the speed advantage is likely to be slight unless you are using lots of procedures and the relevant procedure is called many times (probably inside a large loop).

```
I%=-1:REPEAT:I%=I%+1:UNTILI%?TOP=13:?(P
AGE+3)=I%+2+?(PAGE+3):?(PAGE+2)=?TOP:FO
RI%=-2TO0:I%?TOP=32:NEXT
```

Program 3. Recovers the lost program

NEXT ISSUE Erasing part of the program from within the program; list- and save-proofing your programs; and hints for cassette file handling.

BBC MICROCOMPUTER

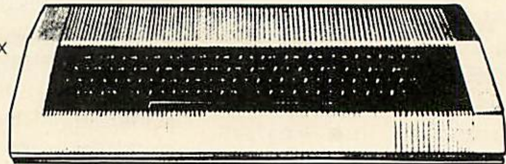


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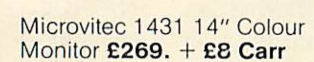
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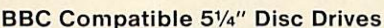
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Joe Telford injects some Christmas spirit into the BBC micro and helps your programs to write their own programs.

PROGRAMS WRITING PROGRAMS

We start this month by examining the *SPOOL command which has two main uses. It can either: store a program on tape or disc in an ASCII format (just as it was typed in at the keyboard); or be used within a program to take printed characters, produced by a program.

The *EXEC command causes the computer to follow the contents of a previously spooled file as if this was being entered by the user at the keyboard.

First, let's use the *SPOOL command conventionally as in the spooling of programs. But why do we need to save programs in this way? Is saving not good enough? The answer is that SAVE and LOAD both operate in internal format, that is to say they copy a section of memory onto tape or disc. However, programs on the BBC micro are not stored in memory, in the same way that they are typed into the computer. Instead, each line has a particular organisation, in which keywords (or reserved words) like PROC or GOSUB or THEN are coded as single characters, as shown in figure 1. We never see the program in this internal format, because when the program is listed, it is printed on the screen in the original ASCII format.

We use an internal rather than ASCII format because the internal one takes up less space. For example, ENVELOPE (eight bytes) is coded as character 226, a single byte, saving seven bytes overall. It is also quicker to look up a single byte to be obeyed during a program than it is to translate eight bytes, as in the case of ENVELOPE, and then look up the matching machine code routine.

So, internal format rules OK! Except when you want to add chunks of program into an already existing one. Every LOAD command commences loading at the beginning of user memory, the location called PAGE. This effectively erases the code already present. It is, therefore, impossible to directly load sections of code into a program. (Though it is possible to append lines of a program using LOAD.)

The answer to merging programs is to use *SPOOL and *EXEC. For example, program 1 is a library routine designed to make a program wait until the space bar is depressed. It can be used in almost any program, and has the benefit that once entered it can be used, from any part of the program, simply by entering:

```
PROC_SPACE
```

It's best to keep such a routine on tape or disc to use whenever needed in the program. This can only be done through the use of *SPOOL. First, type NEW to clear memory, then enter the library routine (either program 1, or a routine of your own) via the keyboard, and check it for errors by test running it with a suitable line, for example:

```
10 PROC_SPACE:STOP
```

When it checks out, remove line 10 (as it is not part of the routine) and think of a suitable name for the routine, eg space. Then type:

```
*SPOOL "SPACE"
```

making sure that you have a blank cassette in the recorder. Press play and record, then press RETURN. You have now opened an ASCII file to save the information. Now type LIST. If the program to be spooled is short, nothing will happen at the cassette recorder, though the program will list on the screen.

To conclude, type *SPOOL. This places the remaining contents of the cassette buffer onto the cassette tape, then closes the ASCII file. To use the spooled program, type NEW and rewind the tape. Type *EXEC"SPACE" then press play on the tape. You should see this:

```
>> LIST
syntax error
> 8100 DEFPROC_SPACE
> 8110 *FX 15,0
> 8120 REPEAT
> 8130 UNTIL GET = 32
> 8140 ENDPROC
>>*SPOOL
syntax error
>
```

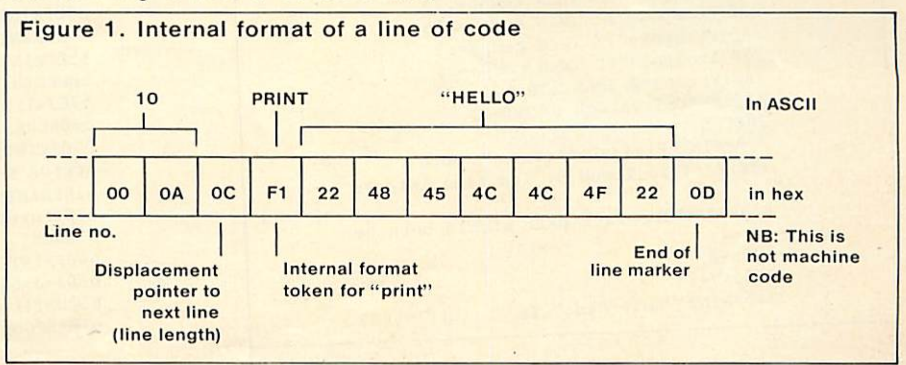


Figure 1. Internal format of a line of code



The first LIST is the one typed to display the program while it was being spooled. The 'syntax error' below it refers to the fact that >>LIST is an illegal command. The *SPOOL after the program is the one typed previously, and the 'syntax error' below refers to the illegal >>*SPOOL.

Despite the syntax errors the program is fine. It can be loaded and what's more it could just as easily have been loaded into the middle of an existing program. A word of warning however. The program which you are execing into contains lines which match the line numbers of the spooled program. After merging is complete, the original lines will have been replaced by those of the library routine. It is, therefore, important to keep track of the line numbers of your library routines. To start you off with some routines, look back through previous Hints and Tips articles, where some of my own library routines are scattered.

As you can see, the *SPOOL *EXEC combination is very useful, but it really comes into its own when you use it to make your programs write their own programs. Remember, if a listing appears on a screen, that listing can be spooled onto tape. It doesn't matter if the listing is actually the printout of a program run.

Programs which write programs are called program generators. Commercial versions such as The Last One and Pearl are expensive and operate over a limited area (mailing lists, invoices, or other file handling tasks). The best way to become used to program generators is to write one, using the features of the BBC micro to help. Our program is called The Musical One (TMO) and is listed as program 2.

The task of a program generator is best explained by looking at figure 2. Data, ie the program's contents, are asked for by the program generator, which processes the information and produces code which can be saved or run. Our generator produces one type of program, which can use different data. Commercial versions would allow not only data to be altered, but whole new and different programs could be created by one generator.

Look at program 2. Here the program input stage extends up to line 410. The parameters needed for our simple music program generator are:

- title (line 80).
- number of verses (lines 120 to 140).
- tempo (lines 180 to 260).
- numerical note value and a numerical time value for the duration of each note (lines 280 to 410).

Once all the data is gathered together, it is easy to produce print statements which write the first three program items above. This is done simply by lines 450 to 560 and is the program within a program. The difficulty arises with making the TMO program produce the correct lines of data for its target program, as it will normally

program 2

```
10REM* TMO
20:
30REM*INPUT INFO FOR NEW PROGRAM
40DIMnv(50),nd(50)
50CLS
60REM*GET NAME OF MUSIC*
70:
80INPUT"Name of music is ",title$
90:
100REM*GET NO: OF VERSES
110:
120INPUT"How many verses  ",nverse$
130nverses=INT(VAL(nverse$))
140IF nverses<1 THEN 120
150:
160REM*GET TEMPO*
170:
180INPUT"Tempo? S=slow M=medium F=fas
t",tempo$
190tempo=0
200IFtempo$="S" THEN tempo=1
210IFtempo$="s" THEN tempo=1
220IFtempo$="M" THEN tempo=.75
230IFtempo$="m" THEN tempo=.75
240IFtempo$="F" THEN tempo=.5
250IFtempo$="f" THEN tempo=.5
260IFtempo=0 THEN 180
270REM*GET VALUES OF MUSIC
280CLS
290PRINT"Please enter each note"
300PRINT"followed by its time interva
l"
310PRINT"The last pair should both be
-1"
320J=0
330J=J+1
340PRINT'"note ";J;" is ";:INPUTnv(J)
350IF nv(J)=-1 THEN430
360IF nv(J)>255 OR nv(J)<1 THEN 340
370PRINT"note time ";J;" is ";
380INPUTnd(J)
390IFnd(J) <1 OR nd(J) > 32 THEN 370
400IFnd(J) = 0 THEN 340
410GOTO330
420REM*PRINT & SPOOL
430CLS
440*SPOOL"MUSIC"
450PRINT"100 tempo=";tempo
460PRINT"110 CLS"
470PRINT"120 P.''";:VDU34:PRINTtitle$
;:VDU34:PRINT
480PRINT"130 FOR verse = 1 TO ";nvers
es
490PRINT"140 READ note,duration"
500PRINT"150 IF note = -1 THEN 190"
510PRINT"160 SOUND1,-15,note,duration
*tempo"
520PRINT"170 SOUND1,0,note,2"
530PRINT"180 GOTO 140"
540PRINT"190 SOUND1,0,0,20"
550PRINT"200 RESTORE"
560PRINT"210 NEXT verse"
570J=1:FLAG=0:L=220
580REPEAT
590PRINT;L;" DATA";
600FOR K=J TO J+5
610PRINT;nv(K);",";nd(K);",";
620IFnv(K)=-1 THEN FLAG=1:K=J+5
630NEXT
640PRINTCHR$(127)
650J=J+6:L=L+10
660UNTIL FLAG=1
670*SPOOL
```

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be the amount of data which varies.

The routine which handles the printing of data statements is from 570 to 660. It begins by setting L (the line number in the target program) to 220. Line 590 to TMO prints this line number with the word DATA. Lines 600 to 630 of TMO print five pairs of numbers in the order, note value then duration. Notice the organisation of line 610 which places commas after each number.

If, as may happen with the last line to be printed, there are not five pairs of numbers, then line 620 caters for this and pops out of the loop. Line 640 is essential to delete the last comma in a line otherwise the target program would never run. Line 650 moves onto the next set of five data pairs, and increases the line number by 10. The loop from 580 to 660 continues until the last data pair (-1,0) is reached, when the music program is complete.

Complete but not operational. All we have done is to have our TMO program print the lines of a new program. We cannot run it yet! Lines 440 and 670 move us closer. As the program is printed on the screen, line 440 spools it onto tape or disc as a file called Music. When this file is fully printed, line 670 closes it. All that remains is to type NEW to get rid of TMO. (If you've just typed it in make sure you save TMO before using it!) Now type *EXEC "MUSIC". The file will return but as it enters the computer it will become a 'real' program which you can run and list.

A word of caution, especially to disc users. Every file you create is called Music, unless you alter the file name of line 440 of TMO. This is best done before using TMO and each time you need a new music file. For example:

```
440 *SPOOL"HANDEL"
440 *SPOOL"MOZART"
440 *SPOOL"ADAMANT"
```

could each be file names for different runs of TMO. Figure 3 is a concise set of instructions for using TMO and its resultant programs.

The problem of how to find some music comes next and I offer figures 4 and 5 as data for two carols, it soon being that time of the year. To produce your own data find a simple organ book, and convert the score to data pairs as shown in the September edition of *Acorn User*. For the benefit of the high powered reader (aren't you all) I suggest adding an algorithm to TMO which allows entry of data pairs in mnemonic (easily remembered) code, so that an entry could be 1G#,DC meaning octave 1 – G# for a time corresponding to a dotted crotchet.

This should not be difficult and perhaps we could include a suitable routine in the letters' page of a future edition. Can I also point out that my coding does not check for all possible errors which could be entered. That too would be a most useful exercise.

Now a problem – how do you put bars on a BBC micro? Full marks if you provided program 3 as your answer. The gaps between the bars are provided by step 16 of line 60. Program 3 runs in 1.55 secs using V.1.00 EPROMS and occupies 84 bytes of memory. Now look at program 4. This one-liner occupies 18 bytes of memory and executes in 0.55 sec. It is obvious that the clever command is the GCOL 34,134. Just what the GCOL command does is explained on page 262 of the *User Guide*. The problem is that only the values of the first GCOL parameter from 0 to 4 are documented in the *User Guide*.

Program 5 looks at some of the possible effects of the GCOL statement. It produces random triangles *ad infinitum*. Line 10 needs a little explanation. It selects a GCOL statement with the first parameter in the range one to 255, and the second parameter as one of the 15 foreground or background

Figure 2 TMO Type Program Generator

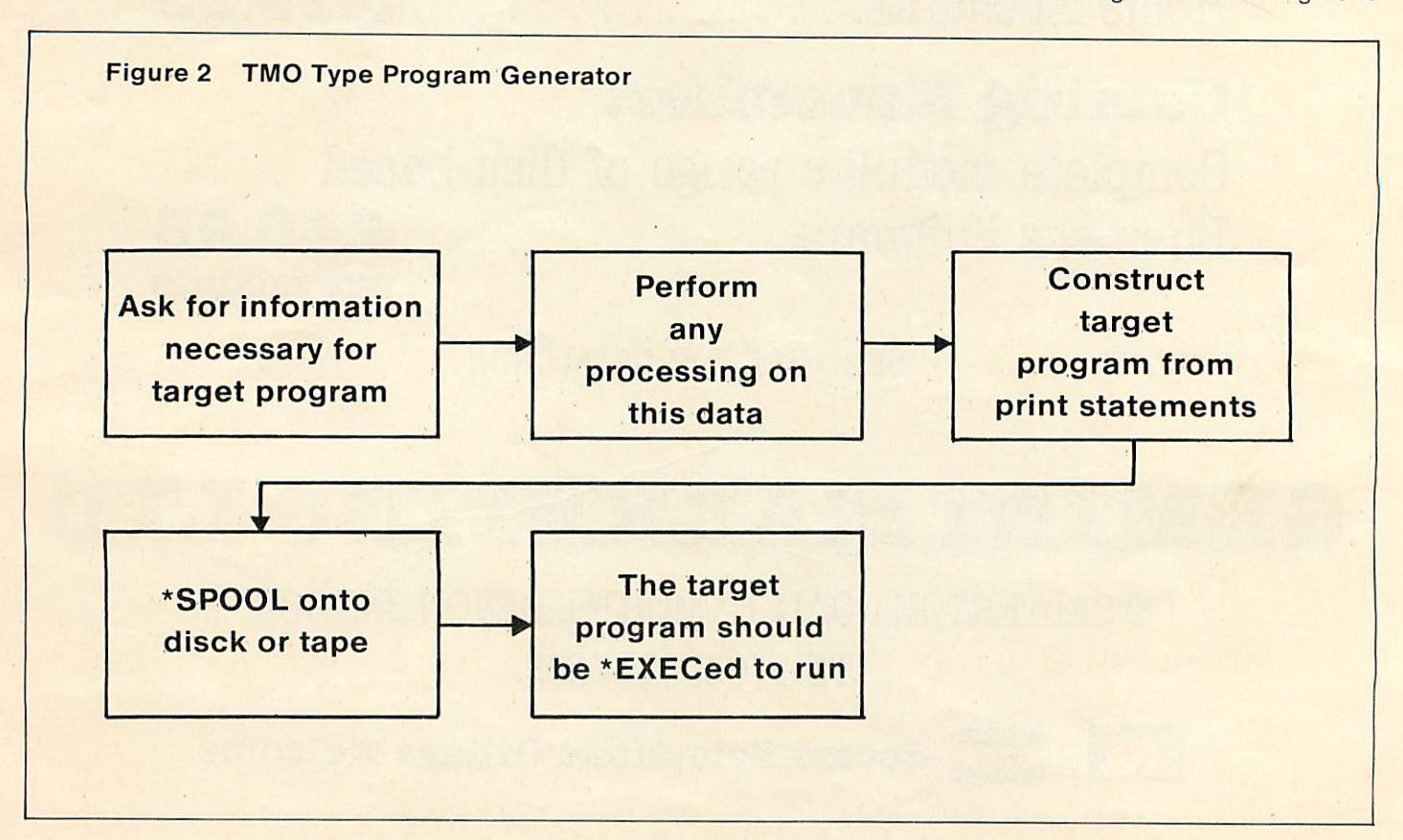




Figure 3
The Musical One

TMO Instructions

1. Load TMO
2. Alter line 440 to the file name of your choice.
3. Run the program.
4. Answer all the questions. Note that mistakes will need the program to be re-run.
5. The target program named in line 440 will spool onto tape or disc so make sure you have a blank tape in the recorder, or room on your disc.
6. When TMO is finished, repeat from step 2 above to create as many programs using TMO as you wish.

To use TMO-created programs

1. Type NEW
2. Type *EXEC "your program's name".
3. After the program has loaded from tape or disc type RUN to hear it play.

The target programs are best re-saved so they can be loaded as normal internal format programs.

colours. Having whetted the appetite with these weird colours, program 6 lets you experiment wth them. For each pair of parameters P1 and P2 entered, the program produces two triangles, the second of which covers half the first, so the effect of repeated plotting can be seen.

Recording all the possibilities will prove difficult. There are 256 first parameters and 32 second parameters, which because of overlaying, give rise to over 67 million effects.

One of the most useful areas to examine with the GCOL command is that of shading. Program 7 displays a number of shades of red caused by varying the gap between parallel lines. Such shading opens the way to more lifelike 3D images.

We conclude this month with program 8, which uses some of the GCOL commands to help produce a Christmas card. For those who query the odd line numbering, it is deliberate; after all you should all want to *EXEC a carol into your Christmas card.

Next month: save your Christmas cash because we look at adding discs to the Beeb . . . Ah, but whose discs?

Program 3

```
L.
  1ØREM PRISON BARS
  2Ø:
  3ØMODE2
  4ØGCOLØ,1
  5ØFOR X%= Ø TO 128Ø STEP 16
  6ØMOVEX%,Ø:DRAWX%,1Ø23
  7ØNEXT
```

program 4

```
  1ØMODE2:GCOL35,134:CLG
```

Figure 4.

Good King Wenceslaus

Note	Duration
81	8
81	8
81	8
89	8
81	8
81	8
61	16
69	8
61	8
69	8
77	8
81	16
81	16
81	8
81	8
81	8
89	8
81	8
81	8
61	16
69	8
61	8
69	8
77	
81	16
81	16
109	8
101	8
97	8
89	8
97	8
89	8
81	16
69	8
61	8
69	8
77	4
81	16
81	16
61	8
61	8
69	8
77	8
81	8
81	8
89	16
109	8
101	8
97	8
89	8
81	16
101	16
81	32

Figure 5.

As with Gladness – Men of old.

Note	Duration
81	8
77	4
81	4
89	8
81	8
101	8
101	8
97	16
69	8
77	8
81	8
69	8
61	8
61	8
61	16
81	8
77	4
81	4
89	8
81	8
101	8
101	8
97	16
69	8
77	8
81	8
69	8
61	8
61	8
61	16
97	8
89	8
81	8
97	8
109	12
101	4
97	16
69	8
77	8
81	8
101	8
97	8
89	8
81	16



Program 5

```
1ØREM COLOURBURST
2Ø:
3ØMODE2
4ØCLG
5ØREPEAT
6ØGCOLRND(255),RND(15)+128*(RND(2)-1

7ØMOVE RND(128Ø),RND(1Ø24)
8ØMOVE RND(128Ø),RND(1Ø24)
9ØPLOT85,RND(128Ø),RND(1Ø24)
1ØØREPEAT UNTIL GET = 32
11ØUNTIL FALSE
```

Program 6

```
1ØREM EXPERIMENT
2ØINPUT"P.1=",P1
3ØINPUT"P.2=",P2
4ØMODE2
5ØGCOL P1,P2
6ØMOVE128Ø,Ø:PLOT85,128Ø,1Ø24
7ØPLOT85,64Ø,512
8ØGOTO2Ø
```

Program 7

```
1ØREM SHADES
2Ø:
3ØMODE1
4ØFOR X= 1 TO 2Ø
9ØGCOL34,7
95MOVE1279,Ø
96PLOT85,128Ø,1Ø24
1ØØGCOL34,6
12ØPLOT85,Ø,1Ø24
135GCOLØ,1
137MOVE64Ø,512
14ØPLOT85,Ø,Ø
145GCOL31,135:CLG
15ØNEXT
```

Program 8

```
2:
3:
4REM USE MODE 2 FOR LOTS OF COLOURS
5:
6MODE2
7:
8REM*NOW LETS HAVE A RED&BLACK WALL
9:
1ØGCOL35,134:CLG
11:
12REM*AND A BLUE CARPET
13:
14GCOLØ,4
15MOVE128Ø,Ø:PLOT85,128Ø,2ØØ
16MOVEØ,2ØØ:PLOT85,Ø,Ø
17:
18REM*ON WHICH IS A RED TUB
19:
2ØGCOLØ,1:MOVE54Ø,1ØØ:MOVE74Ø,1ØØ
21PLOT85,44Ø,3ØØ:PLOT85,84Ø,3ØØ
22:
23REM NOW WE NEED A XMAS TREE
24REM SO WE DESIGN A FORMULA
25REM AND PUT IT IN A FUNCTION
26REM AT THE END OF THE PROG.
27:
28REM SET TOP AND CENTRE LINE
29REM OF TREE WHICH HAS TO BE GREEN
3Ø:
31X=64Ø:Y=95Ø:GCOLØ,2
32:
33REM DRAW TREE
34:
35FOR Y1=95Ø TO 32ØSTEP-4
36PLOT69,FNX(Y1)+X,Y1
37DRAW-FNX(Y1)+X,Y1
38NEXT
39:
4ØREM PUT A BAND AROUND THE TUB
41:
42GCOL33,1:MOVE49Ø,2ØØ:MOVE79Ø,2ØØ
43PLOT85,48Ø,225:PLOT85,8ØØ,225
44:
45REM PUT A TRUNK ON THE TREE
46:
47GCOL33,4:MOVE62Ø,3ØØ:MOVE66Ø,3ØØ
48PLOT85,62Ø,32Ø:PLOT85,66Ø,32Ø
49:
5ØREM PUT THE LIGHTS ON
51:
52FOR J% = 1 TO 15Ø
53Y=RND(63Ø)+32Ø:X=31Ø+RND(63Ø)
54IF POINT(X,Y)<>2 THEN53
55GCOLØ,RND(8)+7:PLOT69,X,Y
56NEXT
57:
58REM DRAW A STAR
59:
6ØMOVE64Ø,9ØØ:GCOLØ,7:DRAW64Ø,1ØØØ
61MOVE59Ø,95Ø:DRAW69Ø,95Ø
62MOVE615,925:DRAW665,975
63MOVE665,925:DRAW615,975
64COLOUR3:COLOUR132
65:
66REM AND FINALLY THE MESSAGE
67:
68PRINTTAB(1,3Ø);"Seasons  Greetings
"
69COLOUR4
999DEF FNX(A)=EXP((Y-A)/12Ø)+(Y-Y1)/5
```



CHILDREN CHALLENGE THE TURTLE

Heather Govier tells us how children in Croydon work with turtle graphics and asks if teachers are ready to let their pupils meet the challenge of Logo.



Logo is a computer language designed for children. It can be used to introduce even five-year-olds to the logical, problem-solving activites needed to programme a computer.

While the full Logo is a powerful programming tool with many capabilities its most commonly cited aspect is turtle graphics, where the child's role is to command a screen pen to draw pictures or patterns. At first these may be simple shapes, such as squares or triangles. Later these elements can be combined in complex and fascinating constructions.

Logo was developed in America in the late 1960s for mainframe computers, but its potential as a programming language for children was quickly noticed. It was first used on a micro with children by Seymour Papert at the Massachusetts Institute of Technology. His work is described in *Mindstorms*, which documents the study and details the philosophical approach underlying all work with Logo. This philosophy, while not exactly novel (it has much in common with that of Rousseau), is still rarely practiced in education.

Essentially, this approach places children in control of their own learning, within an environment (the Logo microworld) designed so that learning inevitably occurs. In the right microworld the child learns thinking skills, mathematics, physics or even juggling in the same way a toddler learns to speak or to walk. The evangelists claim that Logo could, and indeed should, revolutionise education.

Perhaps the most important tenet of the Logo philosophy is that learning should be fun. Almost all teachers who have been introduced to Logo have enjoyed working with it. Because the tasks are open-ended, stimulus and challenge can be found at all levels.

Implementations of Logo are now available for most micros and are appearing for the BBC micro. However, full versions of Logo have a complex syntax which is difficult for young children to use.

The London Borough of Croydon (and other places) have incorporated the screen graphics functions of

Croydon Logo Project

LOGO CHALLENGE

Authors: Heather Govier and Malcolm Neave
Project Adviser: Paul McGee

Logo Challenge is an interactive problem-solving program aimed at children aged 9 to 13 years, whereby the children are involved in programming a microcomputer to draw an infinite variety of pictures and patterns.

In response to an appropriate sequence of commands, a 'screen pen' can be made to draw geometric shapes and patterns. Using the BASIC language, **Logo Challenge** simulates the 'turtle graphics' of the LOGO language developed by Seymour Pappert at the Massachusetts Institute of Technology. What appears on the screen and the movement of the 'pen' is entirely dependent on the sequence of commands typed in by the pupil.

Any drawn picture can be stored in an individual or group 'file' for retrieval and use at a later stage in more complex drawings. **Logo Challenge** is versatile in allowing pupils to input and store their own unique programs, and can also be used time and again without repetition and with a varied age and ability range.

Logo Challenge is intended for use with small groups of 2 to 4 pupils, to allow for group participation and decision making.

Pupil Book

The Pupil Book provides a series of structured *Lessons* on using the program commands. Following each *Lesson* is a section of *Challenges* enabling pupils to explore and experiment with the 'turtle' graphic features of the program.

The contents of the Pupil Book include *Lessons* on:

- Introduction to the program
- Exploring **Logo Challenge**
- Turning the pen
- Using REPEAT-AGAIN loops
- Saving your work
- Editing
- Variables
- Index of commands

Teacher's Guide

The Teacher's Guide provides full details of the program, from starting up the program and explanation of the commands used to complete program solutions to all the *Challenges* in the Pupil Book.

Compatibility

The program will be available on cassette for use with BBC Acorn Model B, Sinclair Spectrum, and Research Machines 480Z, and on disk for use with Research Machines 380Z.

Availability

Logo Challenge is available as a Teaching Pack in four different versions for the machines mentioned above. Each pack contains the cassette or disk, one copy of the Pupil Book, and one copy of the Teacher's Guide. The Pupil Book is also sold separately in packs of five.

Teaching Pack for BBC Acorn Model B (cassette)	£14.95
Teaching Pack for Sinclair ZX Spectrum (cassette)	£14.95
Teaching Pack for Research Machines 480Z (cassette)	£14.95
Teaching Pack for Research Machines 380Z (disk)	£19.95
Pupil Pack (five copies of the Pupil Book)	£11.95

All prices are approximate. Please complete the coupon below if you would like to order **Logo Challenge.**



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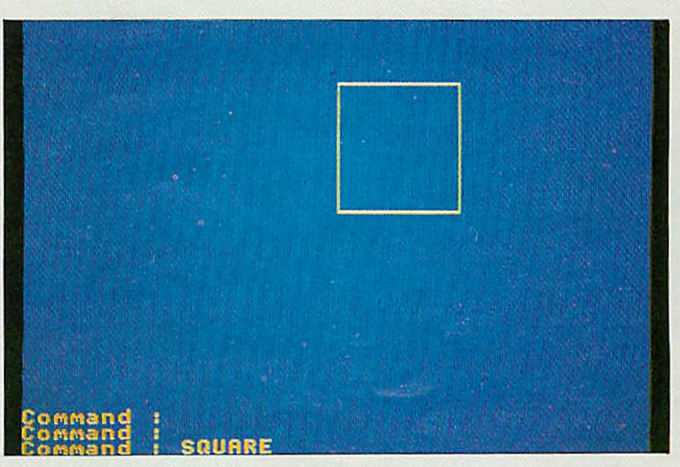
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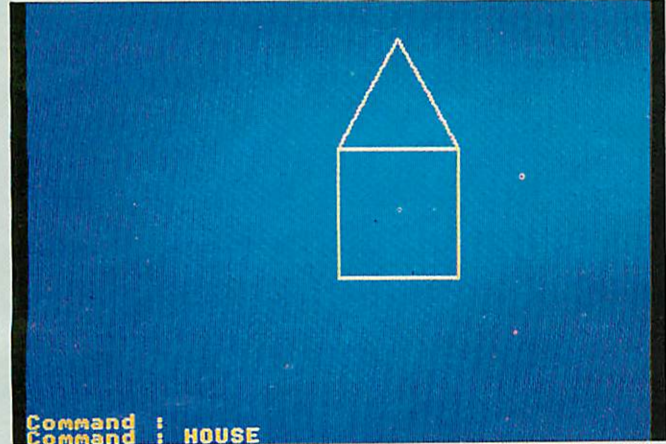


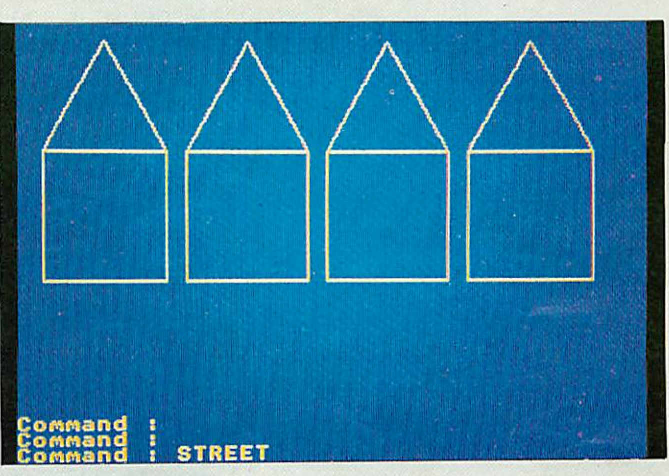
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Four of the stages in drawing a street.

Logo in a Basic program. This program, called *Logo challenge*, with accompanying pupils' book and teacher's notes is to be published next spring by Addison-Wesley Publishers. It will be available for all three micros available under the Department of Industry scheme, namely the BBC model B, the Research Machines 480Z, and the Sinclair Spectrum. A disc version for the 380Z will also be produced.

Trials have taken place with able pupils in the third and fourth years of junior school (9-11 years). However, the potential of *Logo challenge* extends to pupils of all abilities and possibly even to younger children.

Experience indicates that a working group of three to four children is best as it is small enough to allow all participants to share in hands-on control and decision making. Any fewer than three would give less scope for discussion and interaction in problem solving. It may also be preferable to have the group fairly well matched in ability. If the range is too great there is a tendency for the quicker children to have solved a problem before the slower ones have even realised it exists.

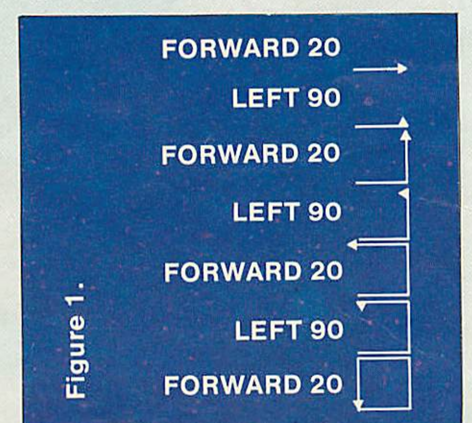


Figure 1.

Initially pupils were introduced to the four commands forward, backward, right and left, followed by a number. This number defines the distance to be moved in the case of forward and backward commands, and the amount of turn in the case of left and right. Left and right commands rotate the pen on the spot through any specified angle.

For forward and backward, the units involved relate to the size of the screen in terms of graphical characters. Children were not told this but allowed to discover the length of a unit themselves. Similarly with younger children, a trial and error approach could be used for the turn commands. Top juniors, who were familiar with angular measurement in degrees assumed this was the system used and suggested that LEFT 90 would produce a 90° turn. Younger children might be inclined to start by typing LEFT 1 or LEFT 5.

Papert decribes in his book how a group of youngsters discovered that they could use LEFT 100 followed by RIGHT 10 to produce a right angle. They used this method for some time before realising it

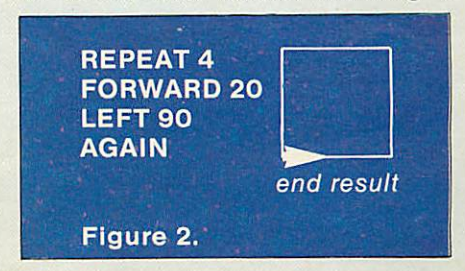
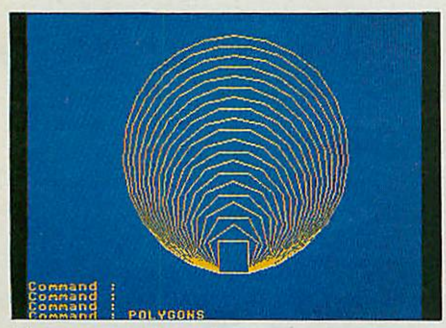
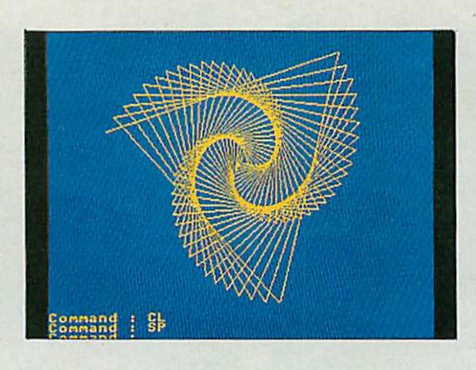
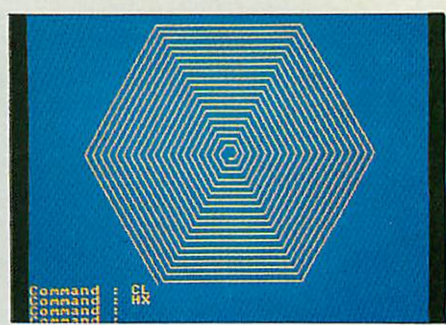


Figure 2.









More complex pictures can be drawn too.

could be abbreviated to LEFT 90. Such an individual approach is to be commended not criticised. The beauty of Logo is that it allows the child to build his or her own thinking and reasoning upon the schemata already present. Knowledge is not presented in the form of facts to be learnt, but is there for discovery.

Having learned forward, backward, left and right commands only, the pupils were challenged to draw a square. Most worked out a procedure similar to that described in figure 1.

Pupils commented that it was very tedious to keep repeating the same commands. This led to the introduction of the repeat-again function. Here the forward and left commands are given inside a

Pupils were able to solve problems for themselves

repeat loop which executes both commands four times (figure 2). This gives a neater and shorter set of instructions.

Such development is central to the Logo rationale where new commands are introduced to pupils as *and when required*, preferably from their responses and needs.

Having drawn a square, pupils were challenged to draw an equilateral triangle. Their first response is shown in figure 3. This was not quite what was intended. They had encountered the first 'bug' in their program.

Pupils were able to solve the problem for themselves given a few pointers. One approach was to get them to pretend that they were the pen and to move in such a way as to draw the triangle on the floor, ie play pen.

```
FORWARD 20
LEFT 60
FORWARD 20
```

end result

Figure 3.

As they did this they thought about the total amount of turn involved in making the full triangle or square. If the pen is to finish with the same orientation and in the same position as it started, it must turn through a full 360°. For a square with four corners, each turn must be 360/4=90° and for a triangle with three, it must be 360/3=120°.

Logo challenge's main value is derived from this debugging procedure. Pupils learn that it is not wrong to make an error in their program. The appearance of a bug simply offers a challenge to be found and corrected. Children thus create their own problems which require solution. Also, there is usually more than one way to write a working program, there is no one correct answer which must be found and marked. If a drawing is completed satisfactorily then the problem has been solved. The pupils can instantly see their success.

It was now possible for our pupils to write a program to draw any regular polygon. As before, such activity was pupil directed with teacher input only where necessary. For pupils to make mistakes and correct them is educationally valuable and there is clearly a great deal of satisfaction to be derived from working things out alone.

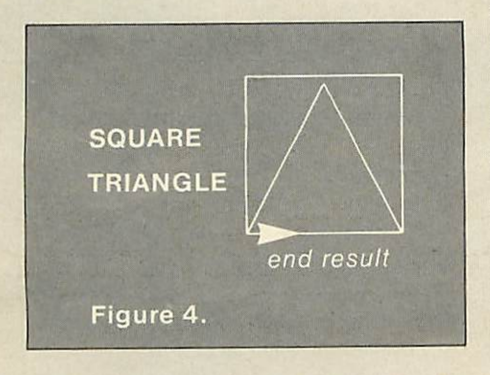


Figure 4.

Pupils were next shown how to store procedures so they could save their squares and triangles. The next step was to combine the two shapes to produce a house.

Pupils were able to debug the program.

'Oh, easy!' they cried. The result is in figure 4.

Again the picture was not quite what they had expected. Here was a further bug in their program, but one which the children could quickly correct. The pen's position at the end of the square was the key. To draw a house it was necessary to move the pen beween square and triangle.

Pupils were then ready for introduction to the variable commands size, angle, number. For example, a group of pupils suggested drawing a number of houses to make a street. However, house had been defined using a large forward instruction (FORWARD 80) and so the house was too large for more than two to fit on the screen. They asked if there was any way that they could make the house smaller without rewriting square, triangle and house. Here was an obvious point at which to introduce both the variables and the edit mode.

Any numerical value can be replaced with a variable. If the variable is then given a value before calling up the procedure it will be drawn with that value. By inserting variables into square, triangle and house the pupils were able to produce smaller houses and thus ultimately a street.

People, trees and cars were needed for their steet but how to draw a circle? So far they had been manipulating only straight lines. Some wanted to duck out of the problem and make do with square heads or wheels, but they were persuaded to attempt a solution.

One approach was yet again to play pen – to walk a circle. When asked to analyse their movements, one said, 'Well, I go forward a bit and turn a bit'. The worked on this idea. How much was a bit? How many times should they turn? Eventually, the routine in figure 5 emerged.

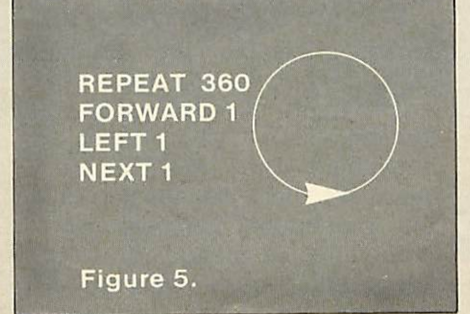


Figure 5.

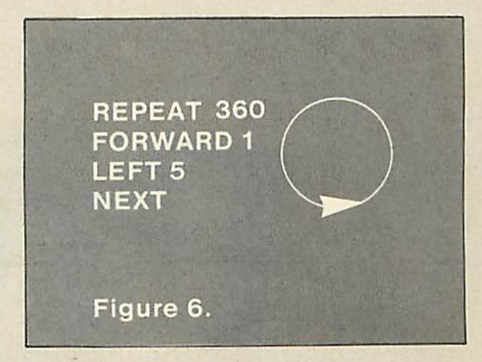


Figure 6.

However, this circle was clearly too big to be a head or a wheel in the larger drawing. How could they draw a smaller circle? Again the pupils played pen and decided that it would be necessary to turn more. They tried figure 6.

This certainly drew a smaller circle but it took a great deal of time as the cursor circumnavigated the circle five times. The pupils quickly spotted that the problem was in REPEAT 360. As each turn was now 5° only 360/5=72 repeats were necessary. By replacing FORWARD 1 by FORWARD SIZE circles of variable sizes could be drawn.

How well will teachers meet this challenge?

After a short time pupils were able to use *Logo challenge* with little teacher guidance. They drew rockets, flowers, spirals, stickmen and a fat man (named after their teacher)! The only limit was their own imagination.

Pupils became hooked, working through breaks and lunch hours. Logo gives pupils the opportunity to show how they can see a lengthy piece of work through to the end. Teachers rarely test the persistence of pupils, and experience with *Logo challenge* suggests that they constantly underestimate it.

Using Logo with pupils should prove an exciting and stimulating experience. It may however be necessary to learn a new humility. In computer programming courses at secondary level pupils frequently progress beyond their .teachers. Logo may well place primary teachers in a similar position. How well will this challenge be met?



Probing procedures

Paul Beverley explains why he'll never use a GOSUB again and describes the delights of procedures – how to use them, how fast they are and how they'll improve your programming

As soon as I discovered procedures on the BBC micro I vowed I'd never use a GOSUB again. Procedures are a bit like subroutines, except more powerful and versatile. But after I had played with procedures for a while, I discovered functions – multi-line ones at that – and began to wonder why BBC Basic bothered with GOSUB at all. I suppose that if they had not implemented GOSUBs then it would not have been compatible with other versions of Basic – but who defines what is standard? It is my contention that procedures and functions would more than compensate for the loss of GOSUBs and would allow a bit of space within the 16k which Basic occupies to put in the WHILE . . . ENDWHILE structure we were lead to expect would be implemented.

Procedures are pieces of code placed outside the main body of the program and called from within, just like subroutines, but they are called by name. As you can see from program 1, naming the procedure aids readability. The program hasn't got a single REM, and yet you should be able to see what the program does without being told more than that it demonstrates the graphics windowing facilities of the BBC micro. (If you have not yet met these techniques, try the program out.)

Procedures are called from within the program by statements like "PROCwindow(number)". This means, 'Execute the procedure called "window", and transfer into it the contents of the variable called 'number'. Or you could say something like "PROCwindow(5)" which transfers the constant 5 into the procedure. The first time a procedure is called, the Basic interpreter looks through the program to find where the PROCedure is DEFined, and remembers this location. Having found DEFPROCwindow(X), it saves space for the variable X, using the space below HIMEM (which is why you are not allowed to change mode within a procedure). X is therefore a variable specific to the procedure and is forgotten once you have left the procedure.

Another feature is shown in "PROCstar". After DEFPROCstar, there is the statement, "LOCAL A%". The interpreter responds by saving more space below HIMEM for the variable A% and like the variable X, this is only used within the procedure. In other words it will not overwrite any other variable called A% that has been used. Again, when you leave the procedure, the local value of A% is forgotten, and that space in memory can be used for local variables in other procedures. This makes efficient use of space for variables and more importantly, it makes the procedure portable. That is to say, provided all variables used within the procedure have been declared as local, the entire procedure can be transported into another program.

You can build up a library of tested procedures which can be stored on cassette or disc. Provided they are given high line numbers, these can be merged with an existing



program.

You can transfer any number of variables into the procedure – real, integer or string, as illustrated by program 2, called Alarm. This is a strange program in that it was never really intended to be RUN, but to be used in immediate mode. The idea is that you type in, for example, "PROCalarm(8,30,"Wake up!!",100)". The computer then sits REPEATedly doing nothing UNTIL

You can build a library of tested procedures.

8.30, and then prints out the required message the specified number of times. When complete, the procedure returns control to the keyboard as it would at the end of a Basic program.

The program itself is trivial, but the idea is important – you can call procedures from the keyboard in immediate mode. This can be a powerful tool in software development. You may have a number of tests which you would like to use at various stages in the development. For example, you may want to look through memory for some particular pattern of data, or to disassemble a section of machine code. So one way of doing this would be to put the procedures into a program at a different page in memory (being careful to leave room for the dynamic variables you are using which are stored above the program). You might have your test routines at PAGE = &E00 and the program under development at PAGE = &1200, so then you could program some of the function keys as follows:

```
*KEY7 PAGE=&E00|M PROCtest1|M
 PAGE=&1200|M
*KEY8 PAGE=&E00|M PROCtest 2(
*KEY9 )|M PAGE=&1200|M
```

If you don't know BBC Basic this will need explaining. When you press key seven, the value of PAGE is changed to the area where your test routines are held and procedure 'test1' is called. When the procedure is complete, PAGE is reset to where the program under test resides. Keys eight and nine do the same for 'test2', but this procedure requires some parameters passed to it, so the call is in two halves, between which the parameters are typed in from the keyboard.

The third example program comes straight out of the *User Guide* and is a solution to the problem known as The Towers of Hanoi. This is in my view an elegant solution, using recursion. As with ordinary subroutines you can, from within one procedure, call another, but recursion is when a procedure calls itself! This program recurs a number of times and, as you can see from the program, changes its variables around as it does so. I don't pretend to understand exactly how the solution works, but I can see that the combination of recursion and variable passing makes for an extremely neat solution. (Compare the solution using subroutines in *Atomic Theory and Practice*, page 42.)

When using subroutines it is generally true with most machines (except the Atom with its labelled lines) that the higher up the program a subroutine is placed, the less delay there is as the interpreter tries to find it.

Thus in applications where speed is critical you would have to use a structure like this:

```
10 GOTO 1000
20 REM The subroutine that is used
30 REM most is placed here.
.
.
.
90 RETURN
100 REM This subroutine is less
110 REM commonly used.
.
.
.
190 RETURN
200 REM Here is the least
210 REM used subroutine.
.
.
.
290 RETURN
.
.
1000 REM Here is the main body
1010 REM of the program.
.
.
.
1900 END
```

When using procedures, this cumbersome structure is unnecessary. Once a procedure has been called, its position is known and on successive calls, there is no delay in finding it. Therefore the speed of calling a procedure is independent of its position, and also of the overall size of the program. Thus we can set out the program more logically with the main body of the program first followed by those procedures which are most 'global' (ie which themselves call other procedures) and finally those procedures which are called by those higher up.

But what about the speed of procedures as compared with subroutines? It takes longer to set up a procedure than a subroutine, but only marginally. If you run the *PCW* Basic benchmark 5 (see November's *Personal Computer World*), you wil find it takes something like 8.84 seconds. If you replace the GOSUB with a call to a procedure and then define the procedure as just ENDPROC, it will take 9.03 seconds. Since this is for 1000 calls, it represents an extrta 200 microseconds per call which is really rather trivial. Also, if the size of the program is increased, the

What about speed of procedures compared with subroutines?

GOSUB timings will increase whereas the procedures will not take any longer. In any case, careful use of procedures enables you to solve a given problem using a smaller amount of code, which would therefore run even faster. That's my opinion, but if you disagree I challenge you to produce a solution for the Towers of Hanoi, using subroutines, that runs as fast as program 3!

I have talked so far about

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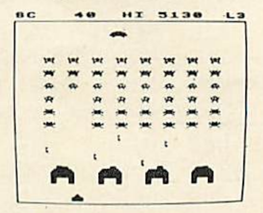
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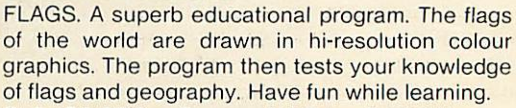


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Program 1 Graphics Windowing

```
10 MODE1
20 PROCinitialise
30 FOR number=1TO7
40   PROCwindow(number)
50   PROCbackground
60   PROCcolourselect
70   PROCpattern
80   PROCcolourselect
90   PROCstar
100  NEXT
110 VDU4
120 END
130
140 DEFPROCinitialise
150 VDU5
160 colour=1
170 VDU19,0,4,0,0,0
180 VDU19,1,2,0,0,0
190 VDU1,2,1,0,0,0
200 VDU19,3,7,0,0,0
210 X%=40
220 Y%=32
230 O%=0
240 P%=1279
250 Q%=1023
260 ENDPROC
270
280 DEFPROCbackground
290 colour=colour+1
300 GCOL0,128+colour
310 CLG
320 ENDPROC
330
340 DEFPROCcolourselect
350 colour=colour+1
360 GCOL0,colour
370 ENDPROC
380
390 DEFPROCpattern
395 LOCAL S%,B%,C%
400 FOR S%=0TO32
410   B%=S%*X%-1
420   C%=S%*Y%-1
430   MOVE B%,O%
440   DRAW P%,C%
450   DRAW P%-B%,Q%
460   DRAW O%,Q%-C%
470   DRAW B%,O%
480   NEXT
490 ENDPROC
500
510 DEFPROCstar
515 LOCAL A%
520 VDU29,640;512;
530 FORA%=0TO500STEP20
540   MOVE A%-500,0
550   DRAW 0,A%
560   DRAW 500-A%,0
570   DRAW 0,-A%
580   DRAW A%-500,0
590   NEXT
600 VDU29,0;0;
610 ENDPROC
620
630 DEFPROCwindow(X)
640 IFX=1 VDU24,690;200;1180;873;
650 IFX=2 VDU24,100;200;590;873;
660 IFX=3 VDU24,440;0;840;1023;
670 IFX=4 VDU24,0;300;1279;700;
680 IFX=5 VDU24,0;0;1279;512;
690 IFX=6 VDU24,0;512;1279;1023;
700 IFX=7 VDU24,0;0;1279;1023;
710 ENDPROC
```

Program 2 Alarm

```
10 CLS
20 PRINT"ALARM PROGRAM"
30 END
40
100 DEFPROCalarm(H,M,message$,times)
110 REPEAT
120   UNTIL TIME>(H*60+M)*6000
130 FORN%=1 TO times
140   PRINT message$
150   NEXT N%
160 ENDPROC
```

Program 3 Towers of Hanoi

```
10 INPUT "Number of disks", F
20 PROChanoi(F,1,2,3)
30 END
40
50 DEFPROChanoi(A,B,C,D)
60 IF A=0 ENDPROC
70 PROChanoi(A-1,B,D,C)
80 PRINT"Move disk ";A;"
   from pile ";B;" to pile ";C
90 PROChanoi(A-1,D,C,B)
100 ENDPROC
```

Program 4 Functions for finding a maximum value

```
10 INPUT A,B,C
20 maximum=FNmax3(A,B,C)
30 PRINT"Maximum value = ";maximum
40 END
50
60 DEFFNmax3(a,b,c)
70 LOCAL p,q
80 p=FNmax2(a,b)
90 q=FNmax2(b,c)
100 =FNmax2(p,q)
110
120 DEFFNmax2(x,y)
130 IF x>y THEN =x
140 IF x<y THEN =y
150 PRINT"Two of them are the same."
160 =x
```

Program 5 Finding the factorial of a number

```
10 INPUT N
20 PRINT FNfactorial(N)
30 END
40
50 DEFFNfactorial(x)
60 IF x=0 OR x=1 THEN =1
70 IF x=1 THEN =1
80 =x*FNfactorial(x-1)
```



passing variables into procedures by putting them in brackets after the procedure call, and also about using local variables whose values are totally independent of any other global variable of the same name, ie they are neither passed into or out of the procedure. How then do we pass variables out of a procedure? It is tempting to try this:

```
10 X = 5
20 PROCinc (X)
30 PRINT X
40 END
100 DEFPROCinc(X)
110 X = X + 1
120 ENDPROC
```

When run this does not give six as an answer, but five. This is because there are two variables called X. The first is a global variable whose value is set as five. It's value is passed into the procedure, but by using X in the definition at line 100, you create a second variable – a local variable – also called X, and it is this variable whose value is increased to six at line 110. If you added 115 PRINT X you would get six, but the value of the global variable X is still five. One way round this would be not to declare X in the definition:

```
10 X = 5
20 PROCincX
30 PRINT X
40 END
100 DEFPROCincX
110 X = X + 1
120 ENDPROC
```

Notice the procedure is now called 'incX', and since X is not made local, the X which is being incremented at line 110 is the global variable. But this misses out on the whole point of using procedures – you should be able to say 'PROCinc(Z)', or 'PROCinc-(number)', or whatever. But behold, there is a better way:

```
10 X = 5
20 X = FNinc(X)
30 PRINT X
40 END
100 DEFFNinc(Q) = Q + 1
```

The function called 'inc' uses a local variable Q which takes on the value passed to it by the call at line 20, and the value created by the expression on the right-hand side of the equals sign in line 100 is passed back into the global variable X at line 20. The same function can now be used in other situations. We can say 'Z = FNinc(Z)', or even 'H = FNinc(J)'.

When this idea is applied to more complex expressions it can produce significant savings in coding. We might for example have a lot of trigonometry to do in a program and would therefore want a set of functions such as:

```
DEFFNside(b,c,A) = SQR(b*b + c*c -
2*b*c*COS(A))
```

What we have seen so far looks fairly tame, and is no better than the facilities available on a number of other micros. What is special about functions in BBC Basic is that they do not have to be defined within a single line. Indeed, not only can they extend over any number of lines, but they themselves can call other procedures or functions and can even be recursive. Two examples are given (programs 4 and 5), and although these could be done as easily by other means, they illustrate in a simple way what multi-line function calls are capable of doing. At first sight the function definitions in programs 4 and 5 look as if they might have one or two typographical errors in them, but that is (hopefully!) not so. Let me explain.

The final statement of a subroutine is of course RETURN, and this returns the interpreter to the line from which the subroutine was called. Similarly with procedures, ENDPROC is the statement which causes the return. Also, the statement causing the return could occur anywhere within the code, including being part of a conditional statement, for example:

```
150 IF N = 7 THEN ENDPROC
ELSE N = N + 1
```

As far as functions are concerned, the equivalent of RETURN or ENDPROC is '= <expression>', or '=<number>'. For example we might say:

```
1000 DEF FNabs(X)
1010 IF X <0 THEN = X*-1
1020 = X
```

So depending on the value passed into the variable X, the value is returned either at line 1010 or line 1020. (These lines could be condensed using ELSE, and Basic has already defined a function called ABS to do the same thing, but this illustrates the point.) Having seen how the syntax works look at programs 4 and 5 and make some sense of them.

Look back to program 1. What else is there which makes it relatively easy to understand?

Between each section of code and the next is a line which consists of a single space. This takes up space in memory and GOTOs and GOSUBs *will* run marginally more slowly, but it makes the program easier to read, and when we've got our second processor boards with 64k of dynamic RAM, we won't be forced into some of the bad techniques limited memory tends to engender, like multi-statement lines.

Lower case characters are used for many of the variables, and for all of the procedure names. To my mind this makes things clearer.

The length of variables is another factor. Longer names make it easier to understand what is happening, but they use up more memory. (Come on Acorn. Where are these second processors?)

When producing listings, it is worthwhile making use of the LISTO facility. By using LISTO 7, the listing is produced with FOR/NEXT and REPEAT/UNTIL loops indented and also has a space after the line number. This enables you to see the structure of the program.

Perhaps this is a minor point, but you will notice PROCinitialise is called only once – so why put it into a procedure? The reason is that when you come to read the program you should not have to wade through all the minor details of initialisation before getting to the main body of the program *with its* windows, colours, backgrounds etc, which, being set out in terms of named procedures, should read a bit like the contents page of a book.

I'm not a programmer by any stretch of the imagination, just an electronics teacher whose programming is virtually all self-taught. But I would like to appeal to those who are publishing material for the BBC micro to make the most of its advanced facilities. I know you have always used subroutines, and so have I, but I hope I *have* put forward a good case for using procedures and functions instead. Hopefully it will help to bring a bit of structure, elegance and readability into our programs and will make life easier for all.

SOFTWARE REVIEW

For the BBC micro ACORN USER December 1982

Pac-men compared

Running the country

Word processing

Feeling adventurous?

BBC-Soft reviewed



FIND YOUR WAY THROUGH A MAZE OF GAMES

Bridgeman, Bridge Software, Model B, £7.90

There are again no written instructions but the tape label tells you to CHAIN "BM". The first screen tells you the keys to use (different ones to *Munchyman)* and the scoring values.

The maze is not very Pac-man like, but is quite a good one. There is the potential for diagonal movement, which is achieved by pressing two keys simultaneously – a nice touch.

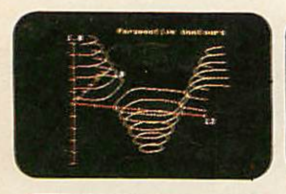
The display is much clearer than *Munchyman* and the pieces and dots are much bigger. The man moves continuously if a key is held down, but the movement is slow. Again there are two ghosts.

As I generally play these games late at night, I do not want loud sound effects. In *Bridgeman* (and *Munchyman*) the sounds are loud, but I was able to reduce the sound levels in the Basic program. At the same time I looked at the programming style. Some structuring of the code using procedures is evident, but the main playing procedure is not broken up enough and too many GOTOs can be seen. (The *Munchyman* code shows no sign of structuring, but can be forgiven as it is a much smaller program).

John Vaux

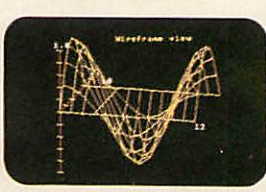
Munchyman, Program Power, Model A, £5.95

This is the cheapest of the three *Pac-man* games reviewed. It is









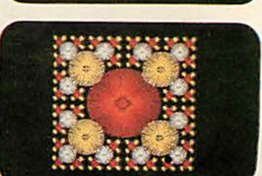












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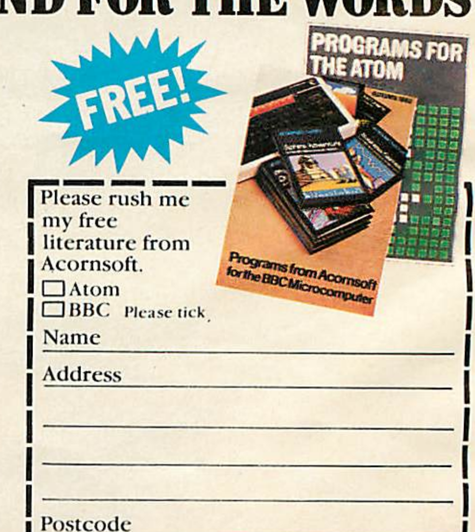
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written in Basic which means that, as it has to be interpreted at execution time, it is slower than a machine code program. There are no written instructions apart from the tape label which tells you to LOAD 'MUNCHYMAN".

A screen appears telling you the keys to use for movement of your man, and the various scoring values. Starting the game reveals a Pac-man maze of some complexity. However, the display is the least clear of those reviewed. The man and two ghosts are small and the dots not very clear. They would probably be clear enough on a monitor, but most people would be using a television. As provided, the man does not move continuously by holding down a key, it has to be pressed for each movement. This is a definitie disadvantage if you are playing for any length of time, needing much finger movement, not to mention wear on the keys. The program is easily modified to give continuous movement using *FX11 and 12, but even then movement is rather jerky.

The highest score from a session is stored and displayed together with your latest score at the end of each game.

John Vaux

Snapper, Acornsoft, Model B, £9.95

This is the most expensive of the three. Except for front-end loading, it is in machine code and thus is potentially faster.

The maze is similar to Pac-man and the display is good. Apart from the fanfare at the start of each game the sound is not too intrusive. The man and the four ghosts move smoothly and at a good speed. There is more to the game than either *Bridgeman* or *Munchyman*. The value of ghosts devoured increases during any one eating period, and there are fruits which appear at various times whose value increases as the game proceeds. Very large scores can be achieved and a ladder of the top eight in a session is maintained to monitor your progress.

The standard of these three *Pac-man* games is in the same order as their price. If you had not seen the other two you would probably find *Munchyman* reasonably satisfying. If you had not seen *Snapper* then *Bridgeman* would proabably keep you happy. *Snapper* is certainly the best on all counts – presentation, graphics, interest and value for money. I thoroughly recommend it.

John Vaux

Beat your Beeb

Chess, Program Power, Model B, £7.95

This program comes with two pages of instructions, which appear to adequately cover the facilities available. The display includes a picture of the Chess board showing the current position, a text area showing the latest moves and a clock which times your moves only. I was not too happy with the display of the chess pieces, as trying to show them as actual pieces makes the difference between them more difficult to see.

There is a useful range of facilities: play, blitz, analyse and replay. Six levels are provided and

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you may play black or white. In blitz mode, the computer plays at its fastest speed and you are allowed 10 seconds for each move – if you fail to move in that time you miss the move – very tricky!

Analyse mode is useful for setting up problem. Replay can be used to rerun the last game played. All in all, a nice implementation which will give the average player a reasonable game at level 2 or 3. Higher levels are too slow unless you are very patient.

John Vaux

Are you game for an adventure?

Colossal Adventure by Level 9 Computing, £10

Colossal Adventure is a faithful implementation of the original Crowther and Woods *Adventure*, written in Fortran on a mainframe computer six years ago. All the creatures, objects and locations, which in the original add up to a staggering quarter of a million bytes, are present in the BBC version. Remarkably, it is available for both 16k and 32k machines.

The game runs in teletext mode without graphics, and involves entering commands in the form of words or short phrases, in response to the description of your current position. Colossal cave has dozens of locations – halls, rooms and passages, some containing treasures, some concealing unfriendly beasts. Objects have to be collected and used correctly to proceed, and since you can only carry a limited number of items, careful planning is needed.

To win the game you have to collect all the treasures and carry them back to where you began. At any point you can find out what your score is, and you can also save your current position on tape and restore it later.

To pack it all in, the program has been written in a special language. Even the 16k version has all the locations and objects, the only difference being that the 32k version has longer messages and descriptions. The program, which is supplied with an instruction booklet and envelope which you can use to receive a free clue, is good value and will give many hours of entertainment.

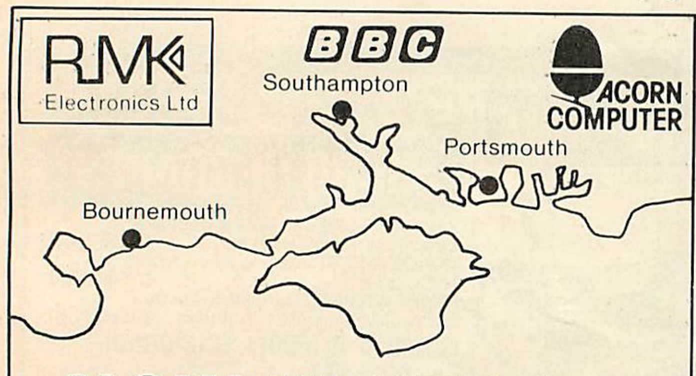
Philip Garritt

Could you do better than Mrs Thatcher?

Great Britain Ltd, Simon W. Hessel Software, Model B, £5.95

This is the first of two financial games produced by the company. You take on the role of Prime Minister and if you think you can do better than Maggie then now is your chance. The game is very good and I enjoyed it.

On every turn you have a budget where you can alter taxes, a budget on benefits and the chance to try some social reforms. If you succeed you get to become Prime Minister for another five years, if you fail severe rioting can occur or other members of your party can rebel and even law and order



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disintegrate. AT the end of five years you get to election day which is very true to life and tense.

This kind of game may sound dull but it is really highly enjoyable. There is no error trapping so if you should accidently touch the escape key you end the whole game. Also, if you should feel generous and introduce a zero VAT rate you get a division by zero error.

Paul Barbour

BBC at play

Games of Strategy (Galaxy, Gomoku, Masterbrain, Reversi), BBC Soft, Model A, £10.

Presentation of this pack is similar to *Fun Games* and the first program is *Galaxy*, yet another *Star Trek* game. This is the fourth program of this kind I have reviewed and is the poorest to date. Again, like the game pack, it is well written but simply lacks imagination.

Next is *Gomoku* which is more interesting than Program Power's version. The computer plays a very fast game but has only one skill level.

Third is *Masterbrain* which is obviously a *Mastermind*. You play two games at once, ie you against the computer and the computer against you (if you see what I mean). It does play a good game and keeps a very careful eye open – should you make one error it prints up 'You cheated' and the computer wins by default. In itself the game is good but after you have seen 'and about time too' ten times in a row it gets tedious.

The final program on this tape is *Reversi* which is an old favourite of mine. Like seven out of the eight Beeb programs it uses the teletext mode.

My overall comments on this game pack are the same as on the *Fun Games* one – each program very good in itself but lacking imagination, and hence disappointing.

Paul Barbour

Fun Games (Breakout, Dodgems, Flash, Snake), BBC Soft, Model A, £10.

This tape was the first of two we reviewed direct from the BBC (although Acorn hold copyright). Both program packs are very well presented and are similar in style to the *Welcome* pack with a better cover design. Each pack has four programs which at £2.50 each are good value for money if the programs are good.

The first is *Breakout*. (Chris Searle was playing it on the *Computer Programme)* It is written entirely in the teletext mode and plays a good game.

Second is *Dodgems* which loads in two parts. The idea is that you have to move around a race track, avoiding a computer controlled car that is constantly trying to crash into you. Neither of these two games are at all imaginative and I had expected better.

The third program is *Flash!*, a computerised version of the electronic game *Simon*. Despite what seems a hard task, considering the layout of a computer keyboard, a very enjoyable and satisfactory game results.

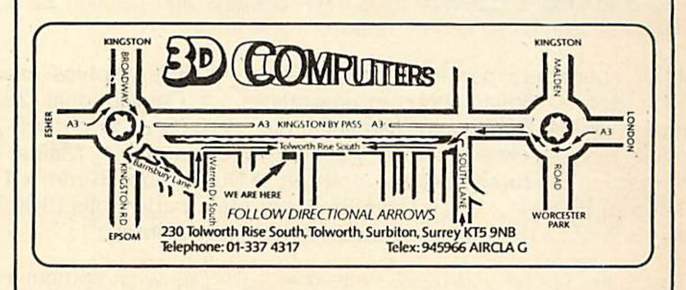
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The final program is *Snake*. This is a good implementation although it would have been better with more advanced graphics.

Overall the BBC Soft games are well written, but disappointing. All are well presented and work smoothly but lack imagination. I would have expected a bit more considering their source.

Paul Barbour

Word processing

Alphabeta, H & H Software, Model B, £28.50

This is remarkable value – a complete word processing package for less than £30. Mind you, it does have one or two limitations and you will need a Seikosha GP-100A printer. You can store up to 224 lines of 80 characters. If you go over this you have to store and resort to trickery to edit (add to or delete from) these complete pages. Using the arrow and various other keys you can delete words and characters and close up the gaps, add words to the middle of paragraphs and push existing text along to make room, centre lines and set up to 10 tabs. You can also implant up to five variables in the text using the function keys. One big problem is that you can't see the whole width of a page at any one time – which makes proofreading a chore. Nevertheless, a useful and relatively inexpensive program. A disc version is promised soon.

Alan Piper

Beethoven would have loved this

Music, BBC Soft, Model A, £10

I found the program very easy to handle taking only a few minutes to get used to the commands. These commands consist of:

0 Record/Edit; 1 Play back; 2 Erase;
3 Load; 4 Save; 5 Tempo;
6 Instrument.

Command 0 gives you a choice of three staves, or lines, to record on, giving, when all played back together, a full sounding 3 line tune. However, a big drawback is that when you have recorded, say on stave 1, and are starting to put another line in, you cannot see the first line you have entered. This, I found, made timing mistakes and getting lost very easy.

Once you have recorded your tune you can play it back using Command 1 and speed it up or slow it down using Command 5, or even change the instrument using Command 6. The four instruments are: organ; harpischord; violin; piano.

The instruments are generally not very convincing. The harpsichord sounds like a 'watery trumpet', the violin is better in terms of realism, but fades out when more than one note of one beat is played in a row. The piano is good but only sounds for around half a second,restricting you to staccato! I found the organ the best for recording and playing back, as it gave a good full sound. But with all four instruments the same problem occurs. If you try to record tied notes (ie holding a key down for more than one beat) you only get the sound of one beat and

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Jason Mallen

Test your tables

Mul-Tabs and Add-Tabs by Cottage Software, £7.50

The review cassette I received refused to load on one side but a phone call brought me a second copy by first post.

The software consists of two programs for learning and testing arithmetic tables. *Mul-Tabs* is for multiplication tables and *Add-Tabs* for addition tables. and they follow a similar format. After a title screen you are told that this method of learning tables really does work if you follow two simple rules. First, you must read the flash each time it comes on the screen and second, use the program for a short time each day not for two hours once a week.

The next screen inquires whether you want to learn a table or take a test – I chose to learn my addition table for four. On a cleared screen flashed 4 + 9 = 13, set to imprint itself on my memory. The screen cleared again and I was asked to complete 4 + 9 =. I managed that one and was duly rewarded with a pat on the back and repetition of the correct answer, then asked to complete 9 + 4 =

I gave the programmer a mental tick for have nicely included commutativity, and got it wrong. It didn't beep at me! The relief was enormous as I hate being beeped at by machines. Instead I was made to repeat the section until my performance was satisfactory, and then back to the learn or test screen.

This time I opted for a test. The questions were flashed up one at a time and no comment made upon my answers until all 20 questions were answered. I was then told my score and how long I'd taken to complete the test, followed by all my wrong answers with the correct ones set alongside.

Finally, I tested for validation by typing garbage. Errors were caught by the message 'Error. Press return to restart.' On pressing return I found the learn or test screen resulted and had to start the whole test again. It would be better to be returned to where I had caused the error, rather than the beginning of the program.

This program was favourably received by pupils and staff in a school.

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Mike Sharp reviews a book for teachers

Learning with the Beeb by Eric Deeson, AVC Software, £2.50

This 16 page booklet contains listings of 10 programs whose aim is 'not just to provide ten educational programs "but also" to provide an opportunity for you to explore various techniques, and various aspects of BBC Basic.' The copyright notice states development, amendment and duplication will only be allowed inside the user's own home or school. This booklet was published in the days of the Provisional User Guide when not all the constraints of BBC Basic were as well documented as they are today.

The ten programs are: *Table Tester* (Primary + remedial); *Guess the Number* (any level); *Guess the Word* (any level); *Reflex Timer* (any level); *Hangperson* (any level); *Train Race* (quiz, any level); *Bar Chart* (primary/middle); *Logo* (any level); *Projectile* (primary game / physics); *Graph* (middle upwards).

Program listings are mostly between 25 and 30 lines followed by a helpful section for the teacher giving pointers for amending the program or installing the data and end with user instructions. The programs were not typeset directly from printer output but different characters are used for zero and letter O, so no confusion occurred on this account. The proportional nature of the printing did give me some problems with counting spaces to be typed as the size of the gap was of little help. The introduction states that programs "are fully mug-trapped" so I started typing and this leads to my first criticism: line numbers. With the AUTO facility it is quite simple for a ham fisted oaf such as myself to type at a moderate speed; why then are the program lines not numbered to allow this feature to be used? We all put lines in during development but why not re-number before publication?

The answer would seem to lie in the existence of a companion volume with the unusual title of *Learining* (yes that is what is says in my copy) *With The Spectrum* and an attempt to make line numbers correspond in both volumes. This may be useful for carrying out comparisons between machines, but I found it a bit irritating. However, as this only applies to some of the programs, it is a minor point. The programs that I typed in *(Logo, Table Tester, Guess The Number, Trains* and *Projectile)* worked once I had sorted my spaces out. The only exception was *Logo* and it was the presentation rather than the program that threw me to start with.

The repertoire of programming techniques used is extensive for such a small book and mostly sound. I say mostly, as one program, *Logo*, contains a GOTO out of a PROC.

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Word processing

In October, Matthew Bates hooked up his Atom to a Sinclair printer. Here he makes use of this inexpensive combination

```
   10 REM WORDPROCESSOR
   20 ?#23=0;?#24=#30
   30 DIM LL100,S10
   40 FORJ=0TO100;LLJ=#100;N.
   50 A=#2800;!A=#2C332435;A!4=#
40F2E30;A!8=#7060000
   60 A!12=#D0F000F;A!16=#706
   70 ?S=30;FORJ=1TO9;J?S=9;N.;S
?10=13
   80 P.$21;FORJ=1TO2;GOS.a;N.;P
.$6
   90 FORJ=0TO18;J?#2820=LL(J+80
);J?#2840=LL(J+80)/256;N.

  100 *SAVE"WP"2800 2E00 2900
  110 END
  120aP=#2900
  130[
  140\INITIALISE
  150:LL100LDA@12;JSR#FFE9;LDA@0
;STA#E1;JSR#F7D1;];$P="LINE"
  160 P=P+LENP;[
  170 NOP;LDA@10;STA#96;LDA@LL14
%256;STA#204;LDA@LL14/256
  180 STA#205;LDA@#40;STA#B80B;L
DA@#FF;STA#B806;STA#B807
  190 STA#B805;LDA@#C0;STA#B80E;
JSRLL85

  200\MAIN LOOP
  210:LL0JSR#FE71;BCSLL56;BIT#B0
02;BVSLL0;LDX@4;JSR#FB83;JMPLL26

  220:LL56JSR#FE66;JSR#FE71;BCCL
L0
  230:LL26JSR#FE71;BCSLL26;STY#9
5;BIT#B001;BVSLL1;JSRLL2;JMPLL5
  240:LL1BMILL3;JSRLL4;JMPLL5
  250:LL3JSRLL6
  260:LL5LDY#95;JSRLL21;JSRLL22;
LDY@0;STA(#93),Y;STA#95
  270 BIT#B001;BMILL7;LDA#95;EOR
@#80;STA#95;LDA#90;CMP@#FF
  280:LL7SEI;LDY@0
  290:LL9JSRLL27;LDA#90;AND@#1F;
CMP@#1F;BNELL10;JSRLL33;JSRLL27

  300:LL10LDA@1;JSRLL12;LDY@0;LD
A(#90),Y;STA#92;CLI;LDA@1
  310 JSRLL13;JMPLL0
  320:LL12CLC;ADC#90;STA#90;LDA#
91;ADC@0;STA#91;RTS
```

This article will turn the Atom and ZX Printer into a useful word processor, and it can be used as a text editor.

The best feature is the program's ease of use, because what you see on the screen is identical to what is stored in the memory. New to Atom owners will be the function which inserts one space and shifts everything after it along one place. Scrolling is automatic, so that, except when near the beginning or the end of the text, you will always be typing on the middle line of the screen.

As the Atom displays inverse characters when shift is pressed, it can sometimes be easy to lose the cursor. To solve this the program generates a flashing cursor using real-time interrupts from the VIA (note that LK2 must be fitted to the Atom board).

The program is written entirely in assembler, requiring just over 5k of text space. This won't fit in a normal 12k Atom's lower text space, so before you enter the program type:

```
?18=#82;NEW
```

Now it will be stored in the graphics memory. When the program is run, the machine code will be assembled into the lower text space. It is advisable to save the assembler now because it will be deleted as soon as the machine

code is run. Note the machine code is saved separately by the program and will prompt you when it is ready.

Machine code means you can type much faster with this word processor than you can with the Atom's normal line editor. It is also less prone to key-bouncing because it scans the keyboard twice before accepting anything.

Text typed in is stored as 128 lines of 32 characters and the top line of the screen always shows what line you are on. The rest of the screen is a 'window' on the text. This is possible because the text is stored as VDU codes rather than ASCII. So displaying the window is simply a matter of copying the text straight into the screen memory. This makes it easy to scroll up or down because all the program has to do is change the address of the window.

Although it may seem odd the program does in fact do all the processing on the text stored internally and copies the window onto the screen every time a change is made, such as typing a character.

Run the program with:

```
*RUN"WP"
```

or

```
LINK#2900
```

if it is already in the memory. The keyboard will now work just like a typewriter in that upper case characters are got by pressing shift (these will appear as inverse).

Editing is simply a matter of moving the cursor to the desired place with the normal cursor control keys and re-typing the mistake. The new control keys are:

DEL	Delete (same as Atom's)
CTRL&DEL	Destructive delete
SHFT&DEL	Insert
CTRL&^	Home cursor
CTRL&N	New
CTRL&P	Print text
CTRL&S	Save text on tape
CTRL&L	Load text from tape
CTRL&U	Page up
CTRL&D	Page down

Finally, remember that if you want to print out some text, load the printer program *before* you run the word processor.

```
330:LL13CLC;ADC#93;STA#93;LDA#
94;ADC@0;STA#94;RTS
340\INTERRUPT ROUTINE
350:LL14LDA#B804;TYA;PHA;TXA;P
HA;DEC#96;BNELL15;LDA@8;STA#96
360 JSR#FE66
370 LDY@0;LDA(#90),Y;EOR@#80;L
DY@0;STA(#90),Y
380:LL15PLA;TAX;PLA;TAY;PLA;RT
I
390\LOOK FOR FUNCTION KEYS
400:LL2LDX@0
410:LL48LDA#2800,X;BEQLL44;CMP
#95;BEQLL45;INX;JMPLL48
420:LL44RTS
430:LL45LDA#2820,X;STA#200;LDA
#2840,X;STA#201;JMPLL46
440:LL4LDX@10;JMPLL48
450:LL6LDX@14;JMPLL48
460:LL21PHP;CLD;JMP#FEB1
470\ASCII TO SCREEN
480:LL22CMP@32;BPLLL23;LDA@32;
RTS
490:LL23CMP@64;BPLLL24;RTS
500:LL24CMP@96;BPLLL25;SEC;SBC
@64;RTS
510:LL25CLC;ADC@32;RTS
520\DISPLAY WINDOW
530:LL29LDA@#88;STA#98;JMPLL32
540:LL30LDA@#96;STA#98;LDA@32;
STA#97;JMPLL32
550:LL27LDA@0;STA#97;LDA#99;CM
P@7;BMILL29;CMP@121;BPLLL30
560 SEC;SBC@7;STA#97;LDA@0;STA
#98;LDX@5
570:LL31ASL#97;ROL#98;DEX;BNEL
L31;CLC;LDA#98;ADC@#88;STA#98
580:LL32LDA#97;STA#80;LDA#98;S
TA#81;INC#81;LDY@0;JSR#FE66
590:LL28LDA(#97),Y;STA#8020,Y;
INY;BNELL28;JSR#FE6B
600:LL29LDA(#80),Y;STA#8120,Y;
INY;BNELL29;RTS
610:LL33LDA#99;CMP@127;BEQLL51
;INC#99;JSRLL39
620 LDA#99;CMP@8;BMILL34;CMP@1
21;BPLLL34;LDA@32
630:LL38SEC;STA#80;LDA#90;SBC#
80
640 STA#90;LDA#91;SBC@0;STA#91
650:LL34RTS
660:LL51LDA@32;JSRLL38;LDA@32;
JSRLL50;RTS
670\CLEAR MEMORY
680:LL85LDA@#88;STA#81;LDA@0;S
TA#80
690:LL37LDY@0
700:LL36LDA@32;STA(#80),Y;INY;
BNELL36;INC#81;LDA#81;CMP@#98
710 BNELL37;JMPLL87
720\INC LN
730:LL39LDX@7
740:LL41LDA#8000,X;CLC;ADC@1;C
MP@58;BNELL40;LDA@48;STA#8000,X
```

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▶ from page 47

```
 750 DEX:JMPLL41
 760:LL40STA#8000,X;RTS
 770:LL42LDX@7
 780:LL43LDA#8000,X;SEC;SBC@1;C
MP@47;BNELL40:LDA@57;STA#8000,X
 790 DEX;JMPLL43
 800\EXEC FUNCTION
 810:LL46SEI;JSR#FE66;LDA#92;LD
Y@0;STA(#90),Y;JSRLL47
 820 JSRLL27;LDY@0;LDA(#90),Y;S
TA#92;CLI;PLA;PLA;JMPLL0
 830:LL47JMP(#200)
 840:LL91JSRLL33;LDA@32;JSRLL12
;LDA@32;JSRLL13;RTS
 850:LL95JSRLL91;LDA#93;AND@#E0
;STA#93;LDA#90;AND@#E0;STA#90
 860 RTS
 870:LL50SEC;STA#80;LDA#93;SBC#
80;STA#93;LDA#94;SBC@0;STA#94
 880:LL53RTS
 890:LL52LDA#99;BEQLL54;DEC#99;
JSRLL42;LDA#99;CMP@7;BMILL53
 900 CMP@120;BPLLL53;LDA@32;JMP
LL12
 910:LL54LDA@32;JSRLL12;LDA@32;
JSRLL13;RTS
 920:LL97JSRLL52;LDA@32;JSRLL38
;LDA@32;JSRLL50;RTS
 930:LL94LDA#90;AND@#1F;BNELL55
;JSRLL52
 940:LL55LDA@1;JSRLL50;LDA@1;JS
RLL38;LDY@0;LDA@32;STA(#93),Y
 950 RTS
 960:LL90LDA#90;AND@#1F;BNELL57
;JSRLL52
 970:LL57LDA@1;JSRLL50;LDA@1;JS
RLL38;RTS
 980:LL96LDA#90;AND@#1F;CMP@#1F
;BNELL58;JSRLL33
 990:LL58LDA@1;JSRLL12;LDA@1;JS
RLL13;RTS
 1000\INSERT A SPACES
 1010:LL59STA#84;LDA@#FF;STA#82;
SEC;SBC#84;STA#80;LDA@#97
 1020 STA#81;STA#83;LDY@0
 1030:LL60LDA(#80),Y;STA(#82),Y;
LDA#81;CMP#94;BNELL61;LDA#80
 1040 CMP#93;BEQLL62
 1050:LL61DEC#80;LDA#80;CMP@255;
BNELL63;DEC#81
 1060:LL63DEC#82;LDA#82;CMP@255;
BNELL60;DEC#83;JMPLL60
 1070:LL62LDA@32;LDY#84;DEY;STA(
#93),Y;DEC#84;BNELL62;RTS
 1080:LL92LDA@1;JMPLL59
 1090\DELETE A CHARS
 1100:LL64STA#84;LDA#94;STA#83;S
TA#81;LDA#93;SEC;SBC@1;STA#82
 1110 STA#80;LDA#83;SBC@0;STA#83
;STA#81;LDA#80;CLC;ADC#84
 1120 STA#80;LDA#81;ADC@0;STA#81
;LDY@0
 1130:LL65LDA(#80),Y;STA(#82),Y;
LDA#81;CMP@#98;BNELL66;LDA#80
 1140 BEQLL67
 1150:LL66INC#80;BNELL68;INC#81
 1160:LL68INC#82;BNELL65;INC#83;
JMPLL65
 1170:LL67LDA@0;SEC;SBC#84;TAY;L
DA@32
 1180:LL69STA#9700,Y;INY;BNELL69
;RTS
 1190:LL86LDA@1;JSRLL64;JMPLL90
 1200:LL80LDA#99;CMP@22;BMILL70;
CMP@121;BPLLL70
 1210 LDA@240;JSRLL50;LDA@240;JS
RLL50;LDA#99;SEC;SBC@15
 1220 STA#99;LDY@15
 1230:LL71JSRLL42;DEY;BNELL71
 1240:LL70RTS
 1250:LL81LDA#99;CMP@106;BPLLL70
;CMP@7;BMILL70
 1260 LDA@240;JSRLL13;LDA@240;JS
RLL13;LDA#99;CLC;ADC@15
 1270 STA#99;LDY@15
 1280:LL73JSRLL39;DEY;BNELL73;RT
S
 1290:LL87LDA@0;STA#99;STA#93;LD
A@48;STA#8005;STA#8006;STA#8007
 1300 LDA@#88;STA#94;LDA@32;STA#
90;STA#92;LDA@#80;STA#91;RTS
 1310:LL74LDA@#FF;STA#93;LDA@#97
;STA#94;LDY@0
 1320:LL76LDA(#93),Y;CMP@32;BNEL
L75;LDA@1;JSRLL50;JMPLL76
 1330:LL75RTS
 1340\SAVE
 1350:LL82JSRLL74;LDA@1;JSRLL13;
LDA#93;STA#88;LDA#94;STA#89
 1360 LDA@#88;STA#87;STA#83;LDA@
0;STA#82;STA#81;STA#86;LDX@#80
 1370 LDA@#8A;STA#80;LDA@13;STA#
8A;JSR#F7D1;];$P=$S;P=P+LENP
 1380[NOP;JSR#FAE5
 1390:LL35JSR#F7D1;];$P=$S;$P+LE
NS="                    ";P=P+LENP
 1400[;NOP;JMPLL87
 1410\LOAD
 1420:LL83JSRLL85;LDX@#80;LDA@13
;STA#8A;LDA@#8A;STA#80;LDA@0
 1430 STA#81;STA#82;STA#84;DEC#8
4;LDA@#88;STA#83;JSR#F7D1;]
 1440 $P=$S;P=P+LENP;[;NOP;JSR#F
96E;JMPLL35
 1450:LL77CMP@32;BPLLL78;CLC;ADC
@96;RTS
 1460:LL78CMP@64;BPLLL79;RTS
 1470:LL79SEC;SBC@64;RTS
 1480\PRINT
 1490:LL84JSRLL74;LDA@#88;STA#91
;LDA@0;STA#90
 1500:LL98LDY@0

 1510:LL99LDA(#90),Y;JSRLL77;STA
#21C,Y;INY;CPY@32;BNELL99
 1520 JSR #378B
 1530 LDA@32;JSRLL12;LDA#91;CMP#
94;BNELL98;LDA#90;CMP#93
 1540 BCCLL98;JMPLL87
 1550];R.
```

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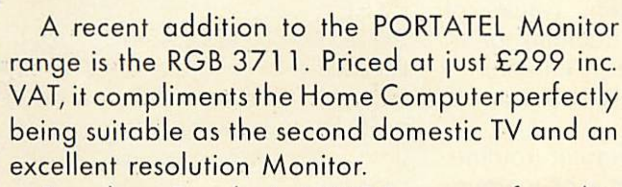
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Barry Pickles reviews two toolboxes for the Atom

TOOLBOX TESTS

Several toolbox routines are available for the Atom and the two reviewed here are typical of the genre. One of the nice things about the Atom (and the BBC Micro) is that operating system routines are vectored (indirectly addressed) through block-zero RAM, making it easy to tag on your own routines by altering the vectors. This is, basically, how toolboxes work.

Each toolbox is supplied as a 4K EPROM, which plugs into the utility ROM socket at IC24 and appears on the memory map from £A000. Both these ROM's are 2532 CMOS types, which means that they are susceptible to damage by static. Each comes in an anti-static pack, complete with instructions.

Programmer's Toolbox comes from the Leeds-based firm of Micro-Power with 8 sheets of instructions which, sadly, omit to warn the user about static damage. The ROM is enabled by the instruction LINK £AF00, which must be performed upon *power-up and* each time that BREAK is pressed. LINKing in the toolbox at this address sets up the 1200 baud cassette system, whilst LINKing to £AF04 sets the COS to the Atom's normal 300 baud. Files are loaded and saved with the normal commands but, with the ROM enabled, each byte of data sent or received is displayed in the top right hand corner of the screen, providing visible indication of loading or saving. If your cassette is inclined to be temperamental, this will come as a great relief. A word of caution, though. Although the 1200 baud system is a great time (and tape) saver, transferring programs is not as easy as at 300 baud. However, if it works with your cassette recorder, this will probably be the most used routine of all.

There are 29 extra commands:

FIND ". . ." This finds all occurrences within a program of the character string contained within the quotation marks, then lists out the line numbers where these occur.

RENUMBER (x,y) This renumbers a program, starting at line x, in steps of y.

AUTO (x,y) This provides automatic line numbering, whenever RETURN is pressed, starting at x in steps of y.

DELETE (x,y) Deletes all program lines from line x to line y inclusive.

ZERO Sets the value of integer variables A to Z to zero.

VAR Prints the current values of variables A to Z in decimal, or in hex if VAR is followed by £(hash).

LVAR Same as VAR, but sends output to a printer.

HEX yyyy A disassembler routine, displaying the contents of memory starting from address yyyy (hex or decimal).

IHEX yyyy Similar to HEX, but the bytes appear in 6502 instruction format ie opcode followed by one or two bytes of data. However, assembler mnemonics are not shown, which makes interpretation as difficult as hand-assembling in hex!

STEP This allows a program to be run line by line. The current line number appears in the top left hand corner of the screen and pressing the spacebar causes the program to execute the next logical line.

TRACE x Similar to STEP, except that execution is halted for a time determined by x (0 to 255). Both STEP and TRACE require that the VIA is fitted and link 2 on the Atom PCB (IRQ) made.

OFF Turns off the action of STEP and TRACE. Essential before any editing is done.

DUMP Dumps the screen (text only) to a printer.

VECTOR Alters the COS baud rate. VECTOR 1 is 1200 baud, VECTOR 0 is 300 baud.

So much for the utilities. The following commands can all be used within BASIC programs:

BEEP x,y Sounds a note of pitch x and duration y. X and y take values between 0 and 255. If x is less than 8, the notes is too high to hear, so this can be used for a programmable delay.

CURSOR x,y This is exactly equivalent to the BBC's PRINT AT (x,y), where x is the column and y the row.

KEY x This is an INKEY routine. The keyboard is scanned and the ASCII value of any key pressed is returned in the variable (x). If no key was pressed, (x) will contain zero. Most useful for games, since it does not halt the program.

INKEY$ x Similar to KEY, but returns the actual character corresponding to the key pressed in $(x). If no key was pressed, a null string is returned. Try as I might, I cannot see how this can produce any effect that can't be produced by KEY.

STOP A debugging routine, sprinkling STOP statements throughout your program will cause the program to halt at each occurrence, until any key (except ESC) is pressed.

POP This has two uses. The first is to allow you to jump out of loops and subroutines at will. The second use, in conjunction with ON ERROR, is to allow a greater depth of nesting than is normally possible.

XIF . . . THEN . . . ELSE A structure, beloved of Pascal users, it works much like the normal IF . . .THEN construct, except that, if the test fails, control passes to the routine

preceeded by ELSE. This can be many lines away. Nesting is allowed and ELSE associates with the last XIF

WHILE . . . ENDWHILE Another Pascal-like structure, it works in the opposite way to a FOR . . . NEXT or DO . . . UNTIL loop, in that the routine is only executed WHILE the condition is true. Loops normally execute at least once, whereas this structure will not execute unless the condition is true to begin with.

READ . . .DATA . . .RESTORE Atom users will greet this one with cries of delight. If you have tried the 'synthesised' version in the Atom manual, this one is easier to use and light-years faster!

ON ERROR This suppresses the normal error handling routine, so that the user can specify what is to happen. Very useful for mugtrapping.

These are all the commands available, but take note!! The *Programmer's Toolbox* like all the others, uses free space available in page zero RAM. Unfortunately, *Micro Power* have chosen to use the area from £80 to £AF, which is commonly used by machine-code routines in much commercially produced software. This means that, after loading, you must BREAK to disable the toolbox, or the program may not run properly. This rules out programs using *RUN. It is not mentioned in the instructions supplied – it should have been!

It has something for everyone from beginner to advanced programmer.

The other toolbox tested comes from the Manchester based firm of *A & F Software* and is called the *Utilikit*. The ROM comes securely packed, in anti-static casing, with an 8-page instruction booklet. The instructions do include a warning against static damage and have very clear fitting instructions. *A & F Software* modestly claim 16 extra commands but, since many of these have multiple options, there are, in fact, 46 new routines and 5 features. Initialisation is carried out in two ways. If the F.Point ROM is fitted, the commands are available immediately and typing COLD will allow use of the features. Otherwise, type LINK £AF00.

After initialisation, you are in 1200 baud cassette mode and the features are: visible load and save; beep after loading and saving; auto-repeat on all keys – the speed of this can be varied by the user and use with REPEAT provides an even faster speed!; fully 'debounced' keyboard (Acorn take note!); extended input buffer – allows you to have program lines (or text strings) up to 208 characters in length. This is not only useful for formatting large amounts of text, it saves memory as you don't use as many line numbers.

Now for the commands. Those already discussed are:

AT x,y (same as CURSOR x,y); ON ERROR;VAR and VAR£;READ and DATA;FAST and SLOW (to alter the cassette baud rate) The rest are different in some way:

COLD has already been mentioned.

WARM can be optionally set to always put you in SLOW mode and can intialise the DOS, if fitted. It is only available if the F.P.ROM is fitted, when it is used after BREAK to re-enable the features.

/LIST x Lists the program from line x or from the beginning if x is not specified. Listing can be halted by pressing the spacebar and 'stepped' by holding it down. A quick tap on the spacebar resumes normal listing. If you press an alphabetical key, the listing scrolls in the opposite direction ie if it was going down, it will scroll backwards!

LINK £AB59 allows you to use the /LIST features within your BASIC program.

DIS xxxx Disassembles from address xxxx. The format is: address/op code/assembler mnemonic/either ASCII data or address.

HEX xxxx Begins a hex dump from address xxxx. Options are as for DIS. All control codes are recognised by HEX or DIS eg CTRL-B (printer on).

ON ESC Works in the same manner as ON ERROR, but is instead enabled by pressing the ESC key. Both ON ERROR and ON ESC perform a POP. ON ESC is disabled by ESC OFF.

RESTORE can optionally RESTORE to a line of DATA.

TONE x,y works as a BEEP, x specifying the pitch and y the duration. However, the pitch has been arranged with values from 0 to 83, corresponding to the keys on a piano (actually, there are 88 keys on a piano, but the last half octave is ignored).

AUTO x,y An auto-number routine, but, if you enter 'page' mode, it will also insert a space after each line number (or label).

BMOVE (x),y to z Complicated this! It allows you to move a block of BASIC program, starting at line x and ending at line y, to a position in the rest of the program at line z. An option RENumber is then prompted.

FIND " . . . ." is a normal FIND, but works on both strings *and* program commands. There is an option to define a second string, after the first one, in which case FIND becomes FIND AND REPLACE, replacing the first string with the second one.

REN x,y renumbers a section of program, from line x to line y.

Finally, the instruction booklet ends with a list of block zero addresses used (£80 to £AD are deliberately left alone, so as not to interfere with programs) and some suggestions for further expansion (!) By the way, the VIA is not needed for any of the toolbox functions.

The *Programmer's Toolbox* is one that I have used for a year now and grown up with. It is very easy to use, the TRACE option is a handy tool and the Pascal-like structures may appeal to some. However, it suffers from its allocation of zero page memory and is slightly more expensive than the *Utilikit* ROM.

I would not have believed that so many facilities could have been provided as are offered by the *Utilikit*. It's not as easy to use as the other toolbox, because of the many options, but it's worth the effort of learning your way around it. From the general user's point of view, it's most endearing feature must be that it has something for everyone, from beginner to advanced programmer, so it will have a long useful life.

The *Utilikit* costs £18.50 and is available from A & F Software (Micro-Link), 830 Hyde Road, Gorton, Manchester 18. The *Programmer's Toolbox* costs £20.70 from: Micro-Power Ltd., Regent Street, Leeds, LS7 4PE

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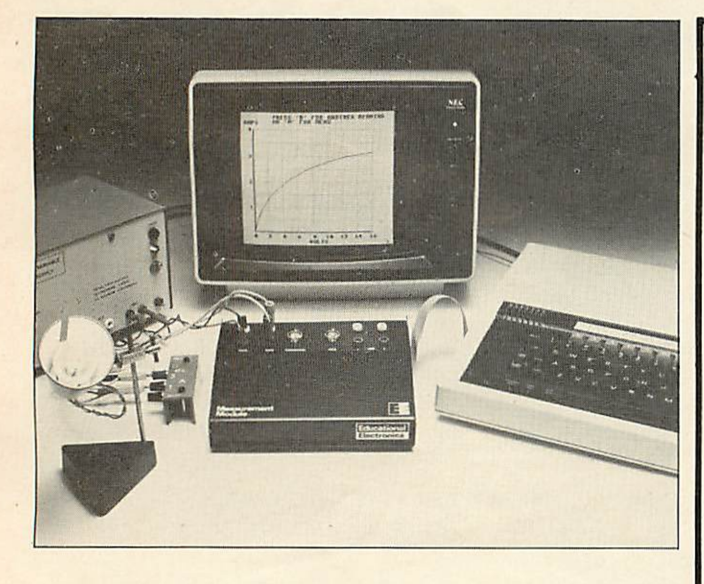
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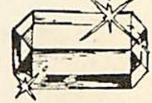
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Andrew Cryer shows you how to get

SIXTEEN COLOURS ON A MODEL A

You don't have to have a model B to get eight ordinary and eight flashing colours plus graphics on a BBC micro. This feature is possible with a model A using only 1k of memory! And the secret lies in mode 7.

Mode 7 provides a teletext screen display of 25 lines each with 40 characters. To get colour on any one line, you need to print a control character on that line. Each of these occupies one character position on the line but appears blank, ie as the screen's background colour. All the text, ie the foreground, to the right of the control character, is affected by the control character; all the text to the left of the control character is not.

A control character can be inserted into a line using either:

PRINT CHR$(n);

or

VDU n

where n is a control code. Possible colour control codes are:

129 for red text
130 for green text
131 for yellow text
132 for blue text
133 for magenta text
134 for cyan text
135 for white text

For example, suppose you want a display on the screen consisting of the single line:

White Green Blue

Suppose that you also want each word to be in the same colour as its name. The following lines of program achieve this using the colour control codes:

```
10 PRINT "White";
20 PRINT CHR$(130);"Green";
30 PRINT CHR$(132);"Blue"
```

The colour code for white, 135, is the default control code. So you do not have to give a control code in line 10, because nothing has come before. For lines 20 and 30, however, which each instruct the printing to be in some other colour, you do have to supply appropriate control codes.

You can control the background colour for each individual line of text. The instruction is the same as for text, except you need two control characters, the first to control the colour and the second to specify that it is for the background. The following control characters change the colour of the background.

156 changes the background to black
157 changes the background colour to the colour given by a preceding colour control code

For example, VDU 130, 157 sets a green background, while VDU 157 sets a white background, because the default colour is white.

Suppose you want to print the following message in blue, with a green background:

Blue on Green background

You would need the following lines of program:

```
100  VDU 130,157
110  VDU 132
120  PRINT "Blue on Green
     background.";
130  VDU 156
```

Line 100 sets the background colour to green. Line 110 sets text in blue and line 120 instructs the message to be printed. Line 130 ensures any further printing will be on a black background; it switches the background colour off by returning to black.

The background of the entire screen can be coloured, without setting each of the 25 screen lines

Program 1

```
10000 DEFPROCcls(C)
10010 VDU 28,0,24,39,0
10020 LOCAL Y,CH
10030 CLS : CH=128+C
10040 IF C<1 OR C>7 THEN CH=132
10050 FOR Y=0 TO 24
10060 PRINT TAB(0,Y);
10070 VDU CH,157,135
10080 NEXT Y
10090 VDU 28,3,24,39,0
10100 PRINT TAB(0,0);
10110 ENDPROC
```



individually, by program 1. Once set, the colour remains, irrespective of any scrolling. Even CLS merely clears the screen to the specified colour rather than to black. The only way to change this colour is to call the procedure again (this time with a new colour number), change the mode or reset the computer.

The number that you specify when you call this procedure is the colour number for the background, as used in any of the other modes, ie:

1 for red
2 for green
3 for yellow
4 for blue
5 for magenta
6 for cyan
7 for white

Numbers between eight and 15 do not give flashing colours as might be expected. With this in mind, the procedure has been written to give blue for any number outside the range one to seven.

There are two points to note with program 1. First, calling it uses up three character spaces at the beginning of each line. As these can no longer be addressed, each line is effectively reduced to 37 spaces. Second, although the procedure sets the foreground colour to white, it can be changed to another colour by altering the last number in line 1070 to the control code for another colour.

Dramatic effects are possible by making some of your text characters flash. Control code 136 causes everything following it to flash between the foreground and background colours, effectively between visible and invisible. This routine causes the word TELETEXT to flash between red (code 129) and the background colour:

```
100 VDU 136,129
110 PRINT "TELETEXT"
```

You can turn off the flashing with the code 137. For example, the following short program makes the word Flashing flash between visible and invisible, ie between red and the background colour, and it prints the word Steady in red which does not flash.

```
100 VDU 136, 129
110 PRINT "Flashing";
120 VDU 137
130 PRINT "Steady."
```

You can also get dramatic effects by doubling the height of text. This feature is available only in mode 7 and is achieved by using two screen lines for every line of text: one for the top half of the text and the other for the bottom half. The doubling is turned on by code 141. So the following two lines of program will print the message double height in characters twice the height of normal characters.

```
100 PRINT CHR$(141);"Double height"
110 PRINT CHR$(141);"Double height"
```

The doubling is turned off with the code 140. So the following two lines of program will produce the message double height in large letters next to the message normal height in normal sized letters:

```
100 PRINT CHR$(141);"Double height";CHR$(140);"Normal height"
110 PRINT CHR$(141);"Double height"
```

Block graphics are available in a similar way to coloured text with the following codes:

145 for red graphics
146 for green graphics
147 for yellow graphics
148 for blue graphics
149 for magenta graphics
150 for cyan graphics
151 for white graphics

These codes cause lower case (small) letters, numbers and punctuation marks to appear as block graphics characters. Upper case (capital) letters are unaffected. For example, in the first of the following two lines, the code 131 causes yellow numbers to be printed. In the second line, 147 causes the printing to come out as yellow block graphics.

```
100 PRINT CHR$(131);"1234567890"
110 PRINT CHR$(147);"1234567890"
```

Each block graphics character is made up of small blobs, three vertically and two horizontally. Thus a wide variety of block graphics characters are available, depending on which of the blobs are lit up. Table 1 gives the different types of block graphics available and their corresponding codes. For example, a line starting with a graphics code will reproduce the CHR$(175) following as a white block instead of /.

Program 2 sets up each line to interpret all the non-upper case text as graphics characters. It also selects a graphics foreground and a background colour in a similar manner to PROCcls(C). Once again, the only way to change this colour is to call the procedure again, or change the mode or reset the computer.

Program 2

```
10200 DEFPROCclg(C,G)
10210 VDU 28,0,24,39,0
10220 LOCAL CH,GH,Y
10230 CH=128+C : CLS
10240 IF C<1 OR C>7 THEN CH=132
10250 GH=144+G
10260 IF G<1 OR G>7 THEN GH=151
10270 FOR Y=0 TO 24
10280 PRINT TAB(0,Y);
10290 VDU CH,157,GH
10300 NEXT Y
10310 VDU 28,3,24,39,0
10320 PRINT TAB(0,0);
10330 ENDPROC
```

In program 2, C has to be given a value to define the background colour. If this value is outside the appropriate range, the background defaults to blue. G has to be given a value to define the foreground colour. If this value is outside the appropriate range, the foreground defaults to white. The colour has to be specified as in PROCcls(C), ie 1 for red, etc. If after calling PROCclg(C,G) you list the procedure you will find all the numbers appear in the listing as block graphics.

Program 3

```
10400 DEFPROCplot(X,Y)
10410 IF X>73 OR X<0 THEN 10480
10420 IF Y>74 OR Y<0 THEN 10480
10430 LOCAL A%,C%
10440 PRINT TAB (X DIV 2,24-Y DIV 3);
10450 C%=S%?((X AND 1)+(2-Y MOD 3)*2)
10460 A%=135
10470 VDU (USR &FFF4 AND &FF00)
      DIV 256 OR C% OR 128
10480 ENDPROC
```

Program 3 plots a point at a position X, Y on the screen. Before you call the procedure, the following set of lines have to have been executed earlier in the program:

```
10 DIM S% 7
20 !S%=&08040201
30 S%!4=&4010
```

The coordinates X and Y must be in

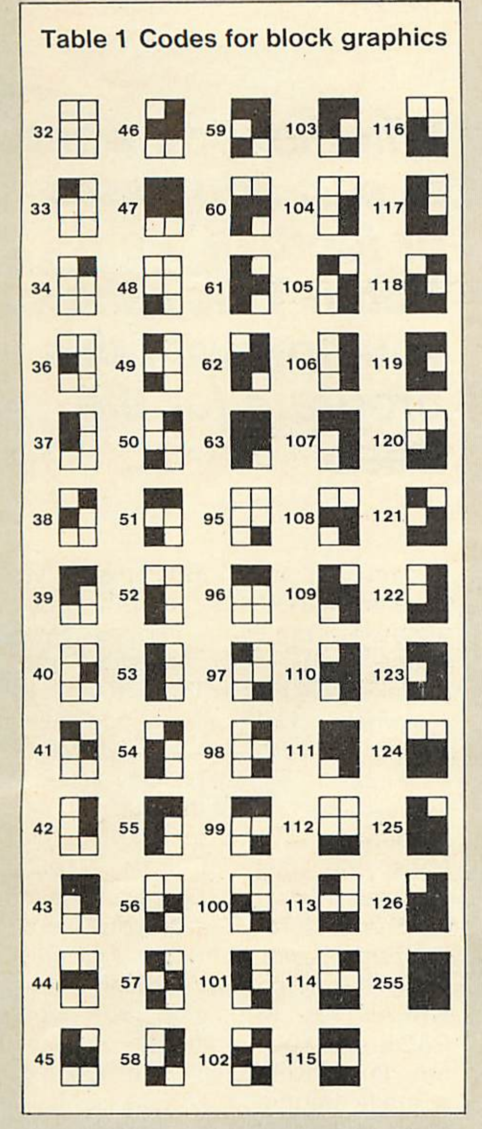


Table 1 Codes for block graphics

the range 0-73 and 0-74 respectively. If the point is outside this range, it will not be displayed. Note that point (0,0) is in the bottom left-hand corner of the screen.

If you want to display lower case text and numbers after using block graphics, control codes 129 - 135 allow you to do so . The choice of control code depends on the colour that you want for the resulting text. Afterwards, block graphics can no longer be displayed on the line. For example the following lines display the first set of numbers as block graphics, and the second as normal text:

```
100 PRINT CHR$(148);"1234567890";
110 PRINT CHR$(132);"1234567890"
```

While using block graphics, you can get an attractive effect with control code 154. This causes each block of graphics to be reduced in size, for example making a continuous line appear as a series of disconnected dots. Code 153 turns off the effect. This is particularly suitable for displaying curves and lines, as they appear less clumsy and of better resolution with the smaller sized blocks.

Double-height block graphics can be obtained in the same way as with text, using the code 141.

When, on one line, while printing a series of the same characters you change the colour, or height or some other characteristic, you normally get a space where the control character goes. This can spoil a graphics display. The problem may be solved by placing control code 158 to the left of the characters. Spaces for control codes will now be occupied with the previous character. This allows continuous graphics displays, even where the colours change. Code 159 turns the effect off. For example, the following lines cause a display of three blocks, followed directly by one green block. No blank spaces can be seen, even though there is a change of colour caused by the code 146.

```
100 VDU 145,255,158,146,255
```

This is in contrast with the effect produced by the following lines which display a single red block followed by a space, where code 146 is stored, followed by a green block:

```
110 PRINT'
120 VDU 145,255,146,255
130 PRINT'
```

Lines 100, 110 and 120 may be put together to show continuous and normal graphics on consecutive lines.

Program 4

```
10600 DEFPROCdraw(X1,Y1,X2,Y2)
10610 PROCplot(X1,Y1) :  PROCplot(X2,Y2)
10620 LOCAL X,Y,L,A
10630 X=(X2-X1) :  Y=(Y2-Y1)
10640 L=SQR((X1-X2)^2+(Y1-Y2)^2)
10650 FOR A=1 TO L
10660 PROCplot(X1+A*X/L,Y1+A*Y/L)
10670 NEXT A
10680 ENDPROC
```

It is always useful to be able to draw a line between any two points. Program 4 does just that. It draws a line from point (X1,Y1) to point (X2,Y2), and relies on PROCplot(X,Y). The points (X1,Y1) and (X2,Y2) correspond to each end of the line which the procedure draws.

Table 2 gives a summary of the various control codes and their effects. Armed with these and the teletext facilities, some very good graphics displays can be generated. So let's see more programs using mode 7.

Table 2 Control codes

Code	Effect
129	Red text
130	Green text
131	Yellow text
132	Blue text
133	Magenta text
134	Cyan text
135	White text
136	Flash
137	Steady
138	Nothing
139	Nothing
140	Normal height
141	Double height
142	Nothing
143	Nothing
144	Nothing
145	Red graphics
146	Green graphics
147	Yellow graphics
148	Blue graphics
149	Magenta graphics
150	Cyan graphics
151	White graphics
152	Concealed display
153	Continuous graphics
154	Separated graphics
155	Nothing
156	Black background
157	New background
158	Hold graphics
159	Release graphics

SOLVE YOUR SORTING PROBLEMS

Whether you want to sort addresses or football teams, Robin Tracy shows you how with this program for the Beeb

Sooner or later you are going to have to sort a list. It may be anything from a list of addresses to a list of teams but they will all be classified as names. In Basic names are held in string arrays, which means each is made up of several letters one after the other. Basic is designed to hold these strings in memory with a pointer to a string's place and length. This is done automatically. You type the instruction DIM Names$ (124) and the computer takes over most of the hard work, setting up a table of pointers, each pointer corresponding to a string of letters.

When inputing names it is likely that they will not be in alphabetical order. Alphabetical sorting will be done later. However, Basic is slow and what is worse, it delays at the very moment you want the program to do something.

A program or subroutine in machine code may come to the rescue. You need a semi-permanent instruction "SORT", to be present all the time. On a microcomputer this is almost impossible but you can go a long way towards it with a section of code that you load before you use the main Basic program. Within the main program you insert the equivalent to "SORT" which looks like:

```
CALL SORT, Names $(0) or
CALL N%, Address $(0)
```

or a similar form. When this section in the main Basic program is encountered, the machine nips off to work on this insertion. This detour lasts less than a second (depending on the number of items in the array) and returns with all strings in the Names$ array in alphabetical order.

It is not possible to be exact about times with a random selection of names, but in tests the program shown here has handled arrays of 1000 names in under two seconds, and you can't fit in much more data!

For the technically minded, this method is based on the Shell sort – first developed by Donald A. Shell and modified to be part of an insertion method. When a swap between names has been made, a further check is made at once to see whether another swap with an earlier item in the list, is needed.

Since this program was written by looking at the Basic listing of Shell's method, that listing is given and tested. It might be useful to compare the Basic version with the assembled version. Experts will complain a comparison is not entirely fair because you should not move strings about in memory, but alter the pointers to the strings. The Basic version does not do this but the Shell assembled version does handle the pointers properly.

Notice that the variables used in the Basic version fit into the plan of the assembled version. But there are two additions, both fairly obvious, which are: a special syntax to call up the code; and a check to see whether the array exists.

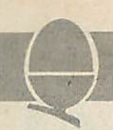
The full listing is sprinkled with comments. These are not needed when the program is entered. Furthermore, many of the instructions may be entered as multi-statement lines, just as you would with Basic. In fact you are in Basic, and the assembler routines take this into account but although you save space you lose legibility and mistakes will be harder to detect.

Switch on the micro and type PAGE = &1000 immediately. (The assembled code has to reside somewhere and in this case it will lie between &0E00 and &0FF.) This frees the memory from &1000 upwards for the program and whichever screen mode you select, the code is not damaged. The only snag happens after pressing the BREAK key, when you must type PAGE = &1000 again. To account for this eventuality the coding actually begins at &0E04 so it is less likely that any damage will result in the assembled program. One way to ease this problem is by:

```
*KEY 10 O.|M PAGE = &1000 |M
```

The test program creates strings with the first four letters the same but the last two letters different. This makes a stern test for any sort program when timed. Under these conditions 1000 strings should take about 2.25 seconds. The program is designed to let you see the array before and after the sort also reporting the time spent in the assembled code.

A word of warning; do not try to sort an empty array, as the coding is not designed for it. The advice is that you should fill the empty area in programs of your own with a duff symbol such as "zz". Then it is a simple matter to keep track of how many strings have been put in to your partly filled array, and there is no need to go beyond that point in print-out etc.



The Shell Sort Program

```
L.
   10REM" Copyrighted  1982 by Robin
 H Tracy
   20REM" SHELL SORT ON ARRAYS MARC
 H 1982
   30MODE7
   40Start   = &80
   50Item    = &82
   60Item1   = &84
   70Item2   = &86
   80Check   = &88
   90WORD1   = &8A
  100WORD2   = &8C
  110Spacer  = &8E
  120End     = &78
  130Temp    = &7A
  140len     = &7D
  150len2    = &7E
  160Shorter= &7F
  170FORZ=0TO1
  180P%=HIMEM-&200
  190S%=P%
  200[OPTZ*2
  210.SORT
  240LDA&600           Array declared ?
  250BEQ none          None declared
  260LDA&603           String array ?
  270CMP#&81
  280BEQ strings       Set correctly
  290.none
  300JMP Error         Leave program
  310.strings
  320LDA&601           Recover start address
  330STA Start         for this array and ke
ep
  340SEC               Prepare to subtract
  350SBC#2             Go back two places
  360STA Item1         Temporary storage
  370LDA&602           Second half of addres
s
  380STA Start+1       Keep this address
  390SBC#0
  400STA Item1+1       Temporary storage
  410LDY#1
  420LDA(Item1),Y Recover length of arr
ay
  430STA End+1         Temporary only
  440LSRA              Divide length by 2
  450STA Temp+1
  460DEY
  470LDA(Item1),Y Recover length of arr
ay
  480STA End           Temporary only
  490RORA              Divide length by 2
  500STA Temp
  510.not
  520LDA#&FF           Ready to calulate len
gth
  530STA Spacer         of Spacer
  540STA Spacer+1
  550LDY Temp+1
  560LDA Temp
  570.rotate
  580CPY Spacer+1
  590BEQ cmp
  600BCS done
  610.cmp
  620CMP Spacer
  630BCS done
  640LSR Spacer+1 Divide by 2
```

Shell Sort Program Continued

```
  650ROR Spacer
  660BNE rotate
  670.done
  680LDX#2             Spacer must span 4 by
tes
  690ASL Spacer
  700ROL Spacer+1
  710ASL End           Prepare to set right
  720ROL End+1
  730DEX
  740BNE done+2
  750CLC
  760LDA Start
  770ADC End
  780STA End           End calulated
  790LDA Start+1
  800ADC End+1
  810STA End+1
  820.Loop             \ Main re entry point
  830LDA Start
  840LDX Start+1
  850STA Item1         Exactly as BASIC
  860STX Item1+1
  870STA Item
  880STX Item+1
  890CLC
  900ADC Spacer
  910STA Item2         Exactly as BASIC
  920STA Check
  930LDA Start+1
  940ADC Spacer+1
  950    STA Item2+1
  960STA Check+1
  970.newlen           \ Shorter string ?
  980LDY#3
  990LDA(Item2),Y
 1000STA len2
 1010LDA(Item1),Y
 1020STA len
 1030CMP len2
 1040BCC short
 1050LDA len2
 1060.short
 1070STA Shorter   Length of shorter str
ing
 1080LDY#0
 1090LDA(Item1),Y Get address of string
 1
 1100STA WORD1
 1110LDA(Item2),Y Get address of string
 2
 1120STA WORD2
 1130INY
 1140LDA(Item1),Y Other half of address
 1150STA WORD1+1
 1160LDA(Item2),Y Other half of address
 1170STA WORD2+1
 1180LDY#0
 1190.next             \ *** THE SORT ***
 1200LDA(WORD1),Y
 1210CMP(WORD2),Y
 1220BCC ok            Strings are in order
 1230BNE swap          Strings are out of or
der
 1240INY               Letters are same so f
ar
 1250CPY Shorter   End of shorter string
yet ?
 1260BNE next          Keep testing
 1270LDA len2          Letters same but -
```

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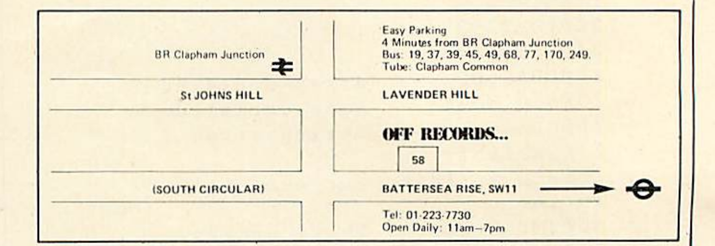
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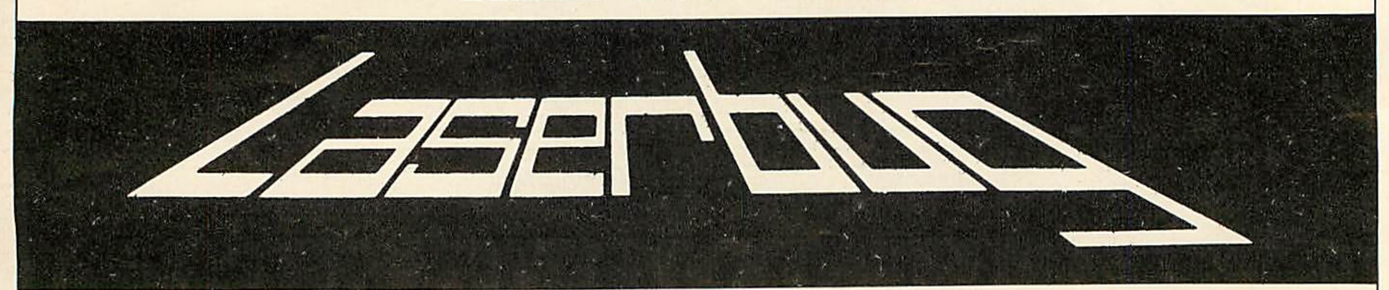


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Shell Sort Program Continued

```
 1280CMP len         shorter  comes first
 1290BCC ok
 1300.swap           \ Exchange the addres
ses
 1310LDY#3           Four bytes to swap
 1320LDA(Item1),Y
 1330PHA
 1340LDA(Item2),Y
 1350STA(Item1),Y
 1360PLA
 1370STA(Item2),Y
 1380DEY
 1390BPL swap+2
 1400LDA Item1
 1410LDX Item1+1
 1420CPX Check+1     BASIC | Item1 > Space
r ?
 1430BNE set1
 1440CMP Check       BASIC | Item1 > Space
r ?
 1450.set1
 1460BCC ok
 1470STA Item2
 1480SBC Spacer
 1490STA Item1
 1500TXA
 1510STA Item2+1
 1520SBC Spacer+1
 1530STA Item1+1
 1540JMP newlen      Try further UP the li
st
 1550.ok CLC         Get next address
 1560LDA Item        Where was I last time
though ?
 1570ADC#4           Adresses are 4 bytes
apart
 1580STA Item1       Exactly as BASIC
 1590STA Item
 1600LDA Item+1
 1610ADC#0
 1620STA Item+1
 1630STA Item1+1
 1640CLC             Exactly as BASIC
 1650LDA Item1
 1660ADC Spacer
 1670STA Item2
 1680LDA Item1+1
 1690ADC Spacer+1
```

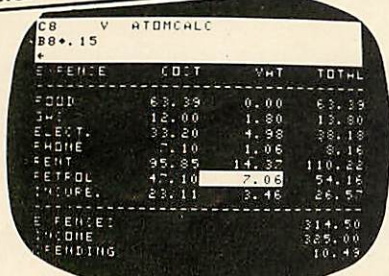
▶ from page 57.

Shell Sort Program Continued

```
 1700STA Item2+1
 1710CMP End+1       Last string ?
 1720BNE new1        More to sort
 1730LDA Item2
 1740CMP End         Last string ?
 1750BNE new1        More to sort
 1760LSR Spacer+1    Divide Spacer by 2
 1770LDA Spacer
 1780RORA
 1790AND#&FC         Spacer must divide by
4
 1800STA Spacer
 1810BNE long
 1820LDA Spacer+1
 1830BNE long
 1840RTS             Spacer = zero ; Finis
hed sorting
 1850.long
 1860JMP Loop        Continue sorting
 1870.new1
 1880JMP newlen
 1890.Error          \ Syntax error detect
ed
 1900LDX#0           in the BASIC program
 1910.Load
 1920LDA M%,X
 1930CMP#&D          End of message ?
 1940BEQ Last
 1950JSR &FFEE       Print letter
 1960INX
 1970BNE Load
 1980.Last
 1990JSR &FFE7       Do carriage return -
line feed
 2000RTS             Leave program
 2010]
 2020M%=P%+1
 2030$M%="Array Error"
 2040NEXT
 2050CLS:PRINTTAB(3,8);"USAGE :"'"To so
rt an array named Team$, enter the BASI
C line"
 2060PRINT"CALL S%,Team$(0)"
 2070HIMEM=HIMEM-&200
 2080REM" Copyrighted 1982 by Robin
H Tracy
>
```

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A. Snell helps you to get to grips with the envelope command with this program which gives a graphical representation of amplitude and pitch envelopes

The sound generation facilities on the BBC micro are generally recognised to be both flexible and powerful. However, the envelope command, with its 14 parameters, is not particularly simple to use – indeed much has been written to help the user come to grips with it.*

Although the articles flesh out the information given in the full *User Guide,* it is not easy to predict in advance exactly how the envelope and sound parameters will interact. This is particularly true in the case of parameters controlling the pitch envelope, where the wrap around can cause some unexpected effects if the pitch variable tries to exceed the range 0 – 255.

The program described here (program 1) was written to help generate sound and envelope commands, avoiding the hit and miss approach that might otherwise be used. It runs on a 32k BBC micro using mode 4, and produces a graphical representation of both the amplitude and pitch envelopes, showing clearly the points at which the control parameters change. The options available to drive the program are continuously displayed at the bottom of the screen.

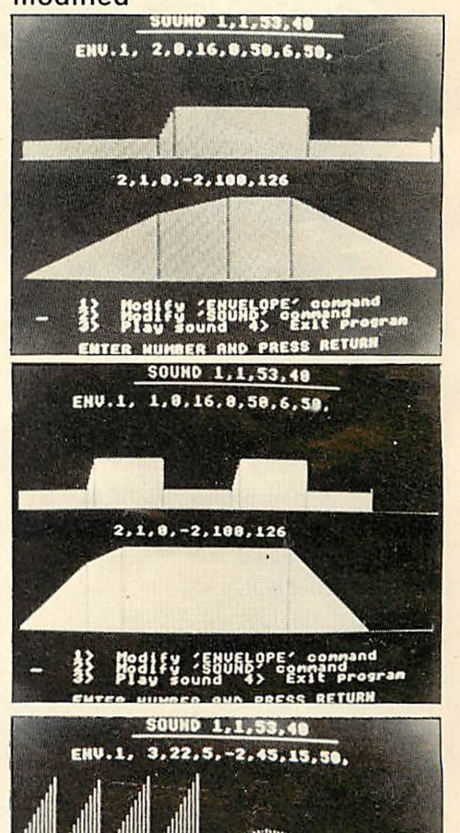
All the parameters in both sound and envelope commands can be individually varied, and the screen display indicates both the current value and the limiting values of the parameter to be modified. The graphical display can either be updated after every modification, or after several changes have been made. The resulting sound is played automatically after the screen update and can be repeated.

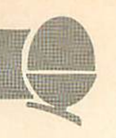
Originally the program was developed to set up envelopes using sound channels 1 – 3, where the pitch envelope has direct relevance. However, channel zero, the noise channel, can also be selected, and with some practice the pitch envelope can be related to the various sound effects produced.

The program supports the full range of values for the timebase parameter, auto-repeating the pitch envelope where appropriate. The sound channel parameter is limited to simply defining the channel number – no synchronization or flushing effects are available. Another slight variation from the standard envelope command, as defined in the *User Guide*, is the restriction of the attack phase parameter AA to the range 1 – 127. In the program's context, negative attack values are meaningless as the target value at the end of the attack phase is always greater than the initial amplitude value.

The only other significant limitation is that the display is restricted to times shorter than 3.2

The screen display indicates both the current value and the limiting values of the parameters to be modified





seconds. This is because of having to represent timebase intervals of 1/100th second on the 320-point resolution of mode 4. If longer times are needed, the program could be run in mode 0, which would double the displayed timescale. In this case, the only alteration to the program is to change the variable SC in line 2010 to read SC=2 not SC=4. The modular nature of the program should make it easy to modify if an even longer timescale is required.

No difficulties should be experienced in running the program as all necessary prompts are given on the screen and the two letter names given to the envelope parameters are sufficiently close to those in the *User Guide*.

References

*Acorn User July, September; *Personal Computer World,* July; *Beebug* April; *The Beebon*, May.

```
   10 MODE4
   20 PROCinit
   30 REPEAT
   40   PROCtext
   50   PROCplotamp
   60   PROCplotfreq
   70   PROCtest
   80   PROCchange
   90 UNTIL exit
  100 MODE7:END
  499:
  500DEF PROCplot(x%,y%,z%,k%)
  501REM ====================
  510 x%=x%*SC:y%=y%*(2-z%)
  520 z%=z%*380+224:y%=y%+z%
  530 MOVE x%,z%:PLOT k%,x%,y%
  540ENDPROC
  999:
 1000DEF PROCinit
 1001REM ========
 1010 DIM NS(5),E(14,2),E$(14),S(3,2),S
$(3)
 1020 VDU28,0,30,39,26
 1030 FOR I=2 TO 14
 1040 READ E(I,1):READ E(I,2)
 1050 READ E$(I):NEXT
 1060 FOR I=2 TO 14
 1070 READ E(I,0):NEXT
 1080 FOR I=1 TO 3
 1090 READ S(I,1):READ S(I,2)
 1100 READ S(I,0):READ S$(I):NEXT
 1110 exit=0
 1120ENDPROC
 1499:
 1500DEF PROCtext
 1501REM ========
 1510 VDU5,16:MOVE380,1000:PRINT"SOUND
";STR$(S(1,0));",";"1,";STR$(S(2,0));",
";STR$(S(3,0))
 1520 MOVE340,960:DRAW948,960
 1530 MOVE160,928:PRINT"ENV.1, ";STR$(E
(2,0));",";STR$(E(3,0));",";STR$(E(4,0)
);",";STR$(E(5,0));",";STR$(E(6,0));","
;STR$(E(7,0));",";STR$(E(8,0));","
 1540 MOVE280,544:PRINTSTR$(E(9,0));","
;STR$(E(10,0));",";STR$(E(11,0));",";ST
R$(E(12,0));",";STR$(E(13,0));",";STR$(
E(14,0))
 1550 MOVE0,600:PLOT21,1280,600
 1560 MOVE0,220:PLOT21,1280,220
 1570ENDPROC
 1999:
 2000DEF PROCplotamp
 2001REM ===========
 2010 Y=0:k=5:TM=S(3,0)*5:SC=4
 2020 TB=E(2,0)MOD128:IF TB=0 THEN TB=1
 2030 FOR I=0 TO 4:NS(I)=0:NEXT
 2040 PROCamp(E(9,0),E(13,0),1)
 2050 PROCamp(E(10,0),E(14,0),2)
 2060 IF Y=0 THEN TMX=NS(2):ENDPROC
 2070 PROCtime(E(11,0),TM,3)
 2080 IF Y=0 THEN TMX=NS(3):ENDPROC
 2090 PROCamp(E(12,0),0,4)
 2100 TMX=NS(4)
 2110ENDPROC
 2499:
 2500DEF PROCplotfreq
 2501REM ============
 2510 Y=S(2,0):k=5
 2520 FOR I=1 TO 3
 2530 IF E(6,0)=0 AND E(7,0)=0 AND E(8,
0)=0 THEN PROCfreq(0,255,0):GOTO 2560
 2540 IF E(I+5,0)=0 THEN 2570
 2550 PROCfreq(E(I+2,0),E(I+5,0),0)
 2560 IF NS(0)*TB>=TMX THEN I=3
 2570 NEXT:IF NS(0)*TB<TMX AND E(2,0)<1
28 THEN 2510
 2580 IF NS(0)*TB<TMX AND E(2,0)>127 TH
EN PROCfreq(0,255,0)
 2590 MOVE160,24:PRINT"ENTER NUMBER AND
 PRESS RETURN"
 2600ENDPROC
 2999:
 3000DEF PROCamp(dY,YT,p)
 3001REM ================
 3010 REPEAT
 3020 NS(p)=NS(p)+TB
 3030 Y=Y+dY
```

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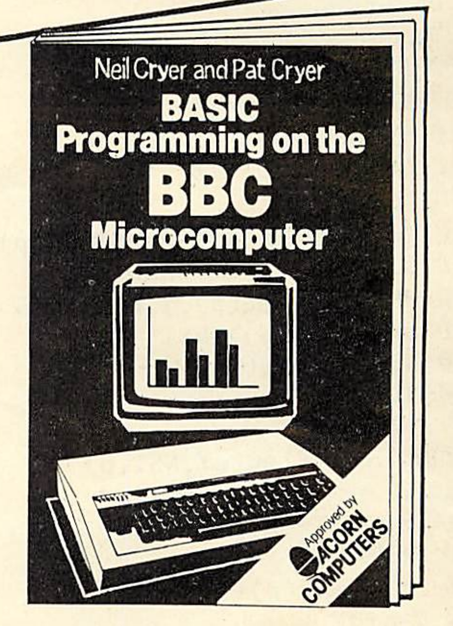
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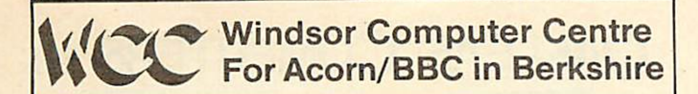




▶ from page 62

```
3Ø4Ø IF Y=YT OR (Y>YT AND Y-dY<YT) OR
(Y<YT AND Y-dY>YT) THEN Y=YT:k=21
3Ø5Ø IF Y<=Ø THEN Y=Ø:YT=Ø
3Ø6Ø PROCplot(NS(p),Y,Ø,k):k=5
3Ø7Ø UNTIL Y=YT OR (NS(p)>=TM AND p<3)
3Ø8Ø NS(p+1)=NS(p)
3Ø9ØENDPROC
3499:
35ØØDEF PROCtime(dY,NST,p)
35Ø1REM =================
351Ø REPEAT
352Ø NS(p)=NS(p)+TB
353Ø Y=Y+dY
354Ø IF Y<=Ø THEN Y=Ø:NST=NS(p)
355Ø IF NS(p)>=NST THEN k=21
356Ø PROCplot(NS(p),Y,Ø,k):k=5
357Ø UNTIL NS(p)>=NST
358Ø NS(p+1)=NS(p)
359ØENDPROC
3999:
4ØØØDEF PROCfreq(dY,NST,p)
4ØØ1REM =================
4Ø1Ø max=NST+NS(p)
4Ø2Ø REPEAT
4Ø3Ø NS(p)=NS(p)+1
4Ø4Ø Y=Y+dY
4Ø5Ø IF Y>255 THEN Y=Y-256
4Ø6Ø IF Y<Ø THEN Y=Y+256
4Ø7Ø IF NS(p)>=max THEN k=21
4Ø8Ø PROCplot(NS(p)*TB,Y,1,k):k=5
4Ø9Ø UNTIL NS(p)>=max OR NS(p)*TB>=TMX
41ØØENDPROC
4499:
45ØØDEF PROCtest
45Ø1REM ========
451Ø ENVELOPE 1,E(2,Ø),E(3,Ø),E(4,Ø),E
(5,Ø),E(6,Ø),E(7,Ø),E(8,Ø),E(9,Ø),E(1Ø,
Ø),E(11,Ø),E(12,Ø),E(13,Ø),E(14,Ø)
452Ø SOUND S(1,Ø),1,S(2,Ø),S(3,Ø)
453ØENDPROC
4999:
5ØØØDEF PROCchange
5ØØ1REM ==========
5Ø1Ø VDU4,12
5Ø2Ø PRINTTAB(5,1);"1> Modify 'ENVELO
PE' command"
5Ø3Ø PRINTTAB(5,2)"2> Modify 'SOUND'
command"
5Ø4Ø PRINTTAB(5,3)"3> Play sound 4>
Exit program"
5Ø5Ø INPUTTAB(Ø,2)" "OP
5Ø6Ø IF OP=1 THEN PROCenv:GOTO 51ØØ
5Ø7Ø IF OP=2 THEN PROCsound:GOTO 51ØØ
5Ø8Ø IF OP=3 THEN PROCtest:GOTO 5Ø1Ø
5Ø9Ø IF OP=4 THEN exit=-1:ENDPROC ELSE
VDU7:GOTO 5Ø1Ø
```

```
51ØØ CLS:PRINTTAB(6,1);"1> Change anot
her parameter"
511Ø PRINTTAB(6,3);"2> Plot new Envelo
pe"
512Ø INPUTTAB(2,2)OP
513Ø IF OP=1 THEN 5Ø1Ø ELSE IF OP<>2 T
HEN VDU7:GOTO 51ØØ
514Ø CLS:CLG
515ØENDPROC
5499:
55ØØDEF PROCenv
55Ø1REM =======
551Ø CLS
552Ø PRINTTAB(Ø,Ø);"2  3  4  5  6  7
8  9  1Ø 11 12 13 14"
553Ø PRINTTAB(Ø,2);"TB,P1,P2,P3,N1,N2,
N3,AA,AD,AS,AR,TA,TD"
554Ø INPUTTAB(2,4)OP
555Ø IF OP<2 OR OP>14 THEN VDU7:GOTO 5
51Ø
556Ø CLS:PRINTTAB(Ø,Ø);E$(OP);" can be
from ";E(OP,1);" to ";E(OP,2)
557Ø PRINTTAB(Ø,2);"Present value: ";
E(OP,Ø):INPUTTAB(22,2)"New value? "NV
558Ø IF NV<=E(OP,2) AND NV>=E(OP,1) TH
EN E(OP,Ø)=NV ELSE VDU7:GOTO 556Ø
559ØENDPROC
5999:
6ØØØDEF PROCsound
6ØØ1REM =========
6Ø1Ø CLS
6Ø2Ø PRINTTAB(8,Ø);" 1      -      2
  3";
6Ø3Ø PRINTTAB(Ø,2);"SOUND  Chan.  Env.
 Pitch  Time  ";
6Ø4Ø INPUTTAB(2,4)OP
6Ø5Ø IF OP<1 OR OP>3 THEN VDU7:GOTO 6Ø
1Ø
6Ø6Ø CLS:PRINTTAB(Ø,Ø);S$(OP);" can be
from ";S(OP,1);" to ";S(OP,2)
6Ø7Ø PRINTTAB(Ø,2);"Present value: ";
S(OP,Ø):INPUTTAB(22,2)"New value? "NV
6Ø8Ø IF NV<=S(OP,2) AND NV>=S(OP,1) TH
EN S(OP,Ø)=NV ELSE VDU7:GOTO 6Ø6Ø
6Ø9ØENDPROC
9999:
1ØØØØ DATA Ø,255,TB,-128,127,P1
1ØØ1Ø DATA -128,127,P2,-128,127,P3
1ØØ2Ø DATA Ø,255,N1,Ø,255,N2
1ØØ3Ø DATA Ø,255,N3,1,127,AA
1ØØ4Ø DATA -127,127,AD,-127,Ø,AS
1ØØ5Ø DATA -127,Ø,AR,Ø,126,TA,Ø,126,TD
1ØØ6Ø DATA 1,Ø,16,Ø,5Ø,6,5Ø
1ØØ7Ø DATA 2,1,Ø,-2,1ØØ,126
1ØØ8Ø DATA Ø,3,1,Chan,Ø,255
1ØØ9Ø DATA 53,Pitch,Ø,254,4Ø,Time
```



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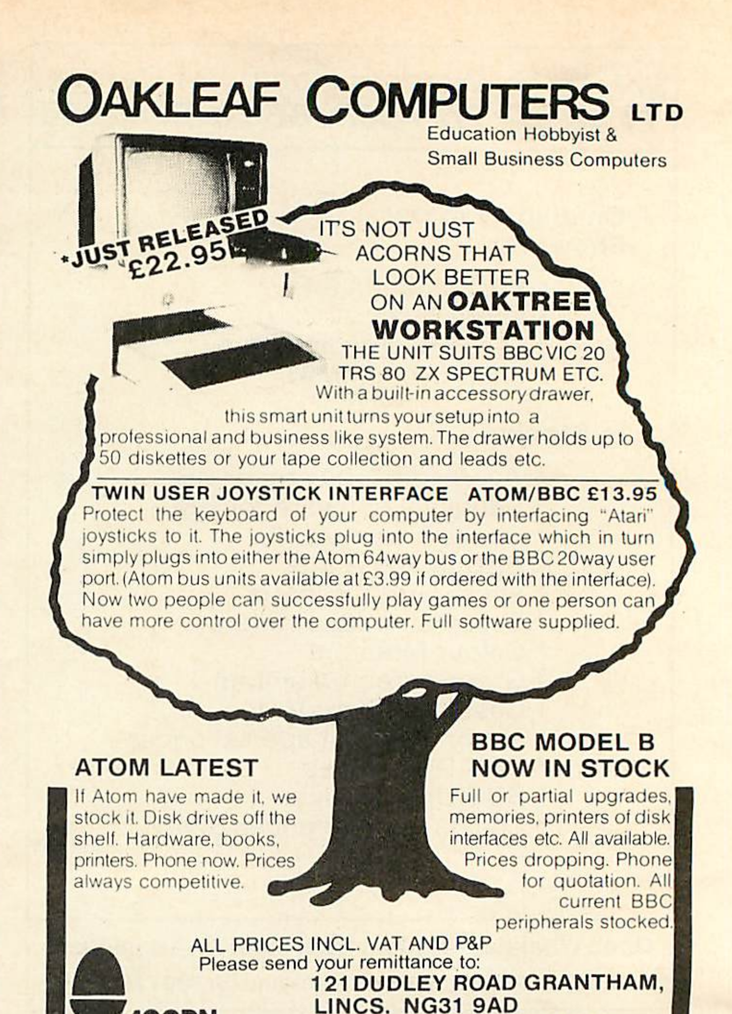
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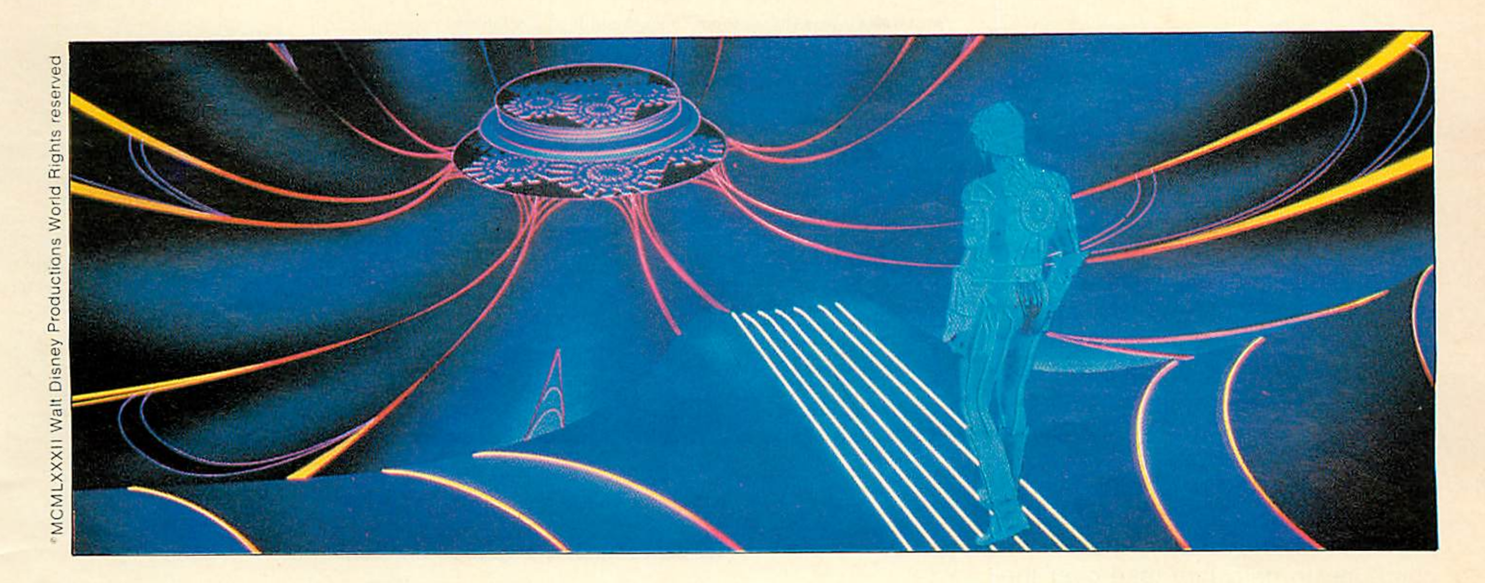
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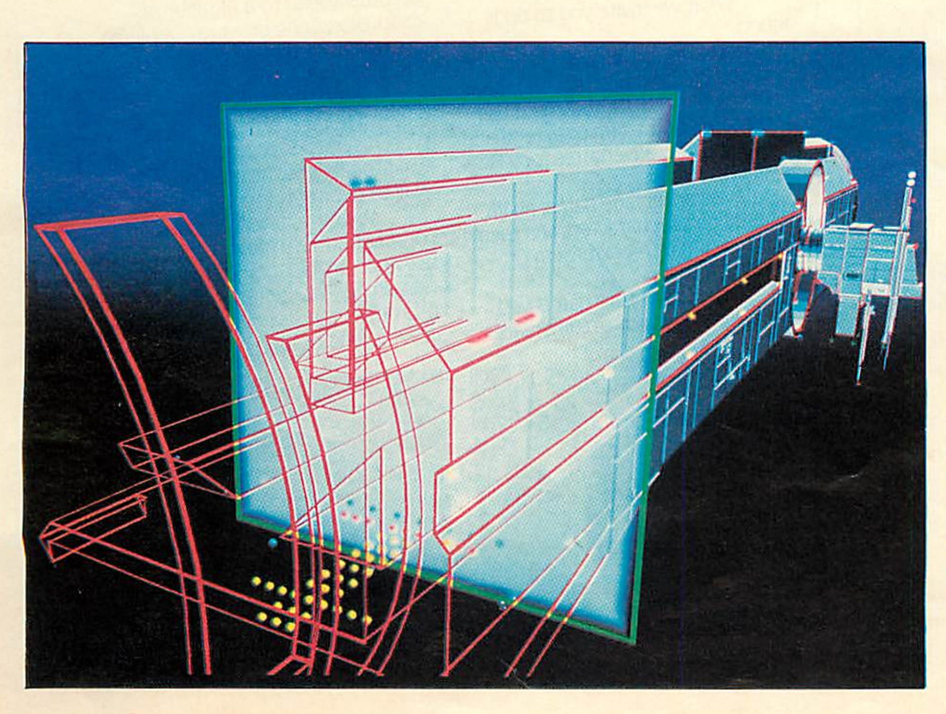


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Schools can win over £15,000 worth of prizes in the competition launched by Walt Disney and Acorn this month.

TRON WINS THROUGH



Disney and Acorn is a strange-sounding partnership – so how did they come together to launch a schools competition? The answer lies in the Electron – Acorn's much-vaunted, but not yet seen, new computer.

Walt Disney wanted to stage a competition with a computer. Acorn, Research Machines and Sinclair were the main choices, and the prospect of the Electron swung the deal. The competition was originally to link the launch of the Electron with *Tron's* debut. However, a reluctant *ULA* scuppered an early launch of the Electron, and now BBC machines are the prizes.

Primary and secondary schools should, by now, have details of the competition which spearheads Acorn's assault on the school market. Acorn has backed up the Government's offer of funding for micros, by the free fitting of Econet interfaces in Model B machines, for schools. Chris Curry believes Econet and schools go hand in hand because the system enables several micros to be linked and



share common hardware such as printers and discs. It also means teachers can monitor and communicate with pupils, as they already do in language laboratories.

The *competition* is based on the plot of *Tron*, and calls on entrants to describe the story – or add to it. This means schools without BBC machines can enter – in fact a computer is not needed at all.

Tron's plot is comparatively simple, as video game warrior comes to the aid of a computer programmer, who has been drawn into the machine by the all-powerful Master Computer Program. The MCP seeks domination inside the computer to help him take over the outside world.

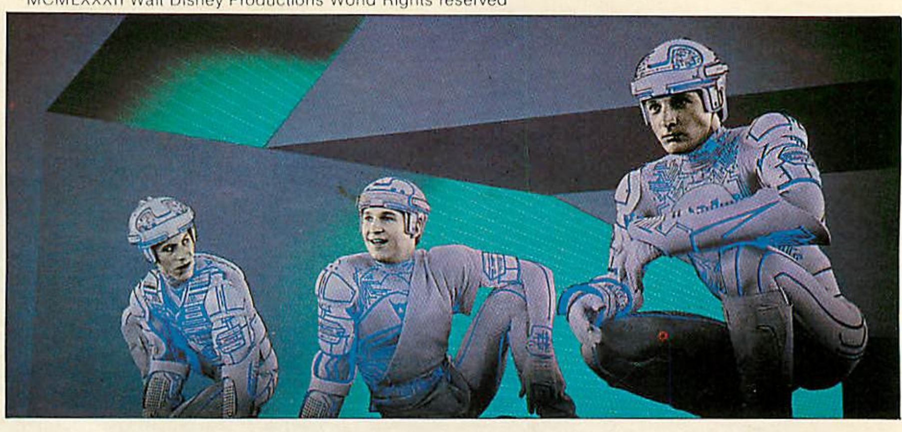
The wonderful world of Disney has spawned a hard, menacing, technological world of video wars and computer graphics. Gone are the days of Mary Poppins and Bambi, their magic has been replaced by the wizardry of *Tron's* computers. But, as in all Disney movies, good triumphs in the end, and the harsh foreboding blues and blacks of the dark electronic landscape are transformed into the bright lights of a world rescued from the brink of disaster.

Setting the film as a view inside a computer has already spawned new video games. The very perils which face the film's heroes, Tron and Flynn, are now being faced by millions of 'vidiots' who monopolise the machine arcades.

Video charts in the U.S. show *Tron* as being number one, knocking Pac-Man from the top spot. The *Tron* game has four parts – a tank battle, light-cycle racing, a *Break-out* variant and a 'beat-the-grid-bugs' section. The 'grid-bugs' make an appearance in the film, but only as a threatening presence. It is almost as if they are shown in the film to justify the game!

With the film, a whole new language is created, although most of it is borrowed from computer jargon. This creates some corny dialogue – for actors and audience. As one youngster remarked to his dad during a *Tron* screening after a video warrior is killed by the MCP's henchman: 'Looks like he's had his chips.'

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A page from the Tron package going out to all schools this month

The Competition

Primary Schools

All you have to do is write the story of TRON in no more than 100 sentences of ten words or less. The school that, in the view of the judges, explains and describes the story of the film in the most exciting way will win.

For example, the first four sentences might be:

1. Encom is an international communications corporation.

2. Flynn, an ex-employee, tries to break into their computer system.

3. Flynn, needs proof that he wrote video games for Encom.

4. Dillinger, an Encom chief executive, claims he wrote them.

Try to describe some of the characters that TRON meets in his adventures as well as just the plot.

Secondary Schools

The competition for secondary schools is, as you would expect, slightly harder.

What we invite you to do is either:

– devise an 'adventure game' based on the characters and theme of the film TRON. You could use passages of the film or extend and develop new adventures for TRON and his friends.

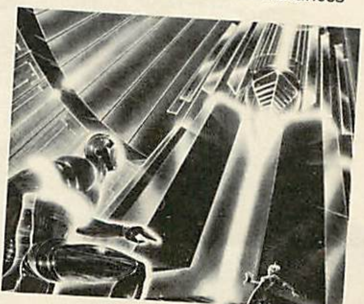
– devise an 'arcade game', again based on the characters and theme of the film or an extension or addition to it.

In the 'adventure game' you should set a series of circumstances with alternatives. These would require a decision to be made, and would eventually lead to a number of conclusions, one of which would be the defeat of the Master Control Program.

The 'arcade game' could be either a point scoring or competitive type. A series of graphical sequences will probably be the most appropriate way to depict your entry.

We have left the scope of the competition very loose to allow you to use your imagination to the full. Remember, you don't have to reproduce the story exactly, you can develop and expand on it.

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Edinburgh Users

We have received this letter from the Edinburgh ZX Computer Club.

Sirs, I am writing to thank you very much for the copies of Acorn User magazine that I have been sent, as secretary of the Edinburgh ZX computer club. I have found both issues of the magazine of a very high standard.

If only Sinclair had this attitude towards their users. As a rather dissatisfied Sinclair customer, I can assure you that a lot of the criticism they come in for in your second issue is justified, but I would hate to see Britain's two leading micro manufacturers get caught up in a slanging match.

I am sure, however that Sinclair and Acorn users have a lot in common, and at the moment our club is considering moving into other small computers. The Electron sounds like a very interesting machine, which I am sure would fit into our club nicely, as I am sure would BBC and Atom users.

To this end, I would be very grateful if you can include us in your user group section.

Keith N. Mitchell
Secretary
ZX Computer Club

The Edinburgh ZX Computer Club was formed in October 1981 out of the mutual interest of owners of Sinclair ZX80 and ZX81 Computers. Membership currently stands at over 70 and now also covers the ZX Spectrum.

Meetings are held every second and fourth Wednesday of each month, in the Claremont Hotel, Claremont Crescent, Edinburgh, from about 7.30 to 10.30pm. Tutorial groups are held at the meetings. A bimonthly newsletter is published. As well as the regular Wednesday meetings, there are also occasional 'Workshops' run all day on Saturdays.

Membership rates are £5 per annum, or £3 for children, students, pensioners and the unemployed. For more information contact: John Palmer (Chairman) 56 Meadowfield Drive 031-661-3183 or Keith Mitchell (Secretary) 19 Meadowplace Road 031-334-8483

Anybody else out there? Contact Acorn User, 53 Bedford Square, London WC1

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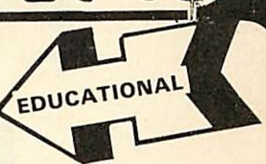
COMPUTER CONCEPTS



LOGO II

MODEL B

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It can graphically demonstrate the ideas of defined procedures, sub routines, loops and even recursive programming. This program will give an excellent introduction to LOGO language, for young and old alike!



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MODEL B

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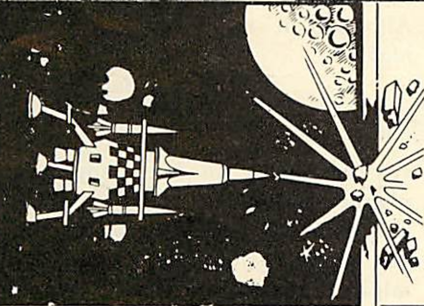


SPACE HAWKS

MODEL B

A great arcade type game similar to the popular space invaders'. A game of skill and speed. Armed with photon bolts to defend yourself — try to beat off the attack of the invaders and flapping space hawks. Makes full use of high resolution graphics.

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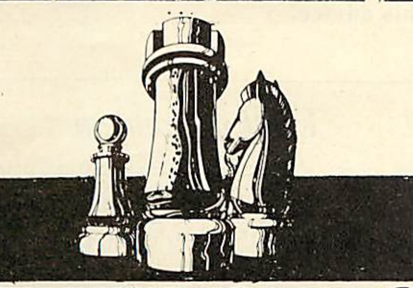


ASTEROID BELT

MODEL A OR B

A great new space game pratically identical to the arcade original. You are stuck in the middle of a cloud of asteroids against which you have no protection — your only chance of survival is to destroy the asteroids with your photon bolts. Manoevring can be achieved by rotating and thrusting. As a last resort you can 'hiper-space', immediately transporting you to a random position.
An inspired piece of machine code programming producing one of the most exciting games around.

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CHESS **MODEL B**

Another machine code program for the Model B. This game has a host of facilities.
An enormous range of skill levels — you can alter such parameters as the number of moves that the program looks ahead, the speed, and sub-levels, etc.
The computer can act as an umpire for two players. It can even play against itself.
This program uses high resolution colour graphics to display the board and its pieces. An excellent introduction to beginners though it still gives the experienced player a real challenge.

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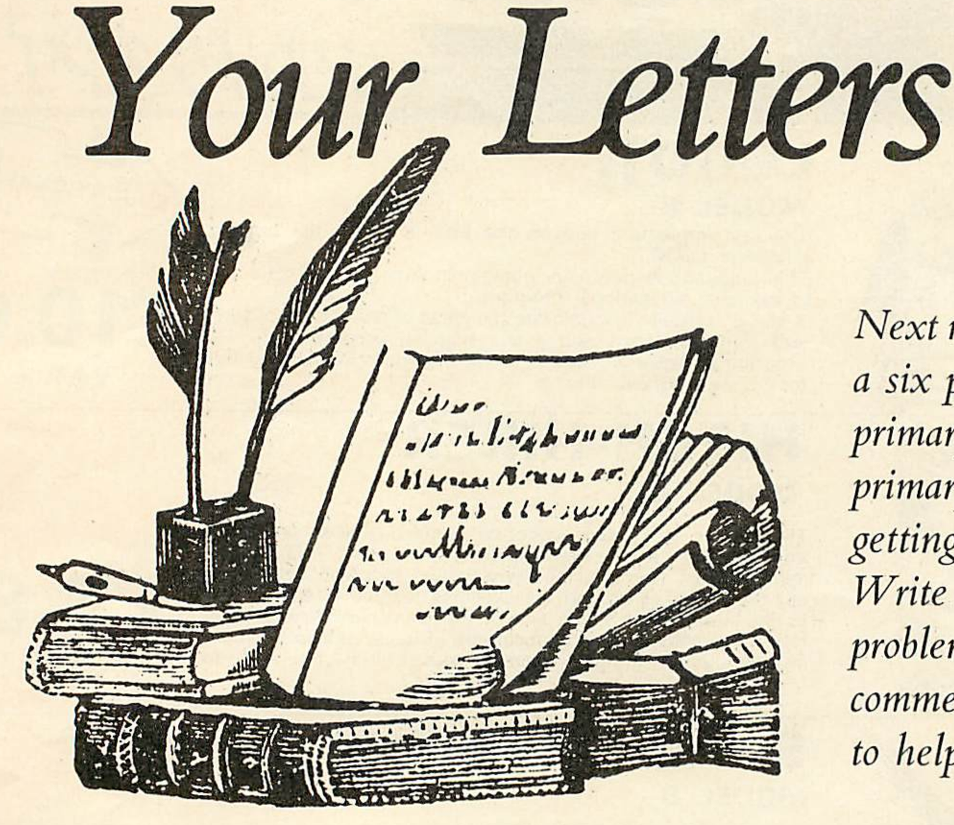
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Next month we are starting a six part pullout series for primary schools. Many primary schools will be getting their first micros. Write to us with your problems, queries and comments. We may be able to help.

Dissatisfied

Sir, I must express my disquiet at Acorn's reply to the letter in the September issue of *Acorn User* concerning the fault in release 0.1 of the BBC machine's operating system whereby programs or files saved on cassette may be lost. It is bad enough that machines have been sold with the fault known to the manufacturer, but ever worse is that the only solution offered is to patch the thing up every time it is switched on. Surely, any reputable company would replace the operating system with a version that worked properly.

Roger Vince
Hampshire

Our information is that the new MOS is fitted free of charge when upgrades are installed. Otherwise you will be charged £10 plus VAT. EPROMs will be changed free of charge.

MOS answers

Sir, In the October issue of *Acorn User* there were conflicting reports on the B.B.C. Machine Operating System conversion from version 0.1 to 1.0 A "clarifying" News item stated that 0.1 EPROM's would be changed free of charge whilst a letter on the same subject was answered with no mention of this, in fact implying the opposite, despite the enquirer stating that he had a Model A (presumably with a fair chance of it having EPROM's). No back reference to the News article was quoted so I am left wondering which to believe. Could you clear this up please?

G. Stroud
Bedfordshire

We are sorry if we confused you. Our latest information appears in the News section. A new operating system known as Series 1 is shortly being introduced by Acorn. The new MOS will be fitted when upgrades are installed. Otherwise dealers will install the new MOS for £10 (plus VAT). Those with EPROMs can have these changed free of charge.

Dots and dashes

Sir, I am the proud owner of a BBC model B micro. When running some programs which involve graphics, however, I am confronted with small areas of dots and dashes across the screen which change their colour every so often. The main area affected is a band running horizontally, about ⅓ of the way down from the top of the screen. The patches are different each time an affected program is run. Although it is bearable it is a bit niggly!

Stuart Robinson
Middx

We are sorry to hear about your niggly problem. It sounds as though you have a problem with your ULA. We would recommend you take your micro along to your local dealer for his advice.

Toolkit problem

Sir, I am writing to seek your assistance with a problem which has arisen in connection with the use of a Program Power (now Micro Power) Toolkit ROM in the Atom Utility socket.

The ROM has an entry point of #AF00, and is enabled by a LINK command to that address. The problem is that I find the necessity of executing the command on POWER up, and more especially after a BREAK reset, a matter of some

continued on page 74 ▶

MICROAGE ELECTRONICS

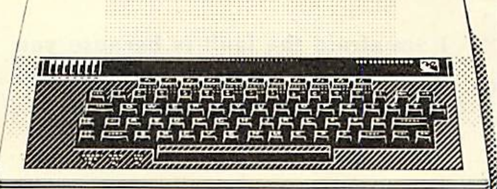
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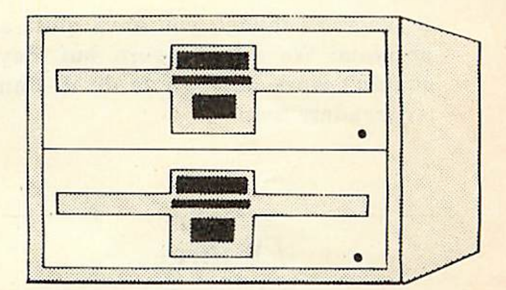
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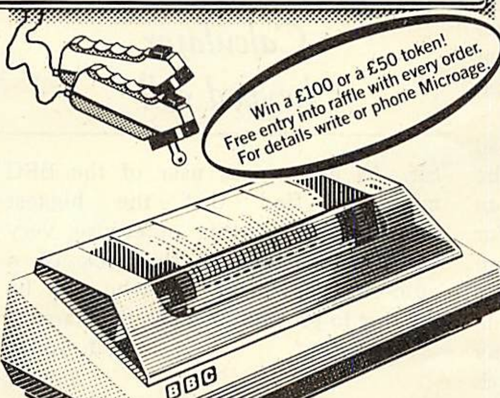
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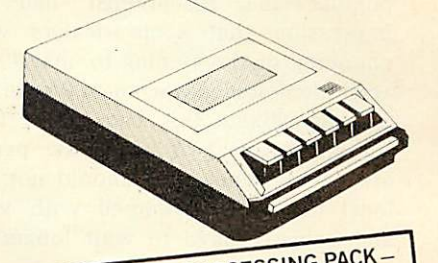
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irritation, and I am seeking a way of hard wiring the ROM (via a physical switch) so that it is normally permanently enabled.

I am fully prepared to incorporate any additional I.C.'s that may be required to perform the desired function, and I should be grateful for any help and advice which you or your readers can offer.

R.J. Parsons
Middx

It seems as though you have quite a problem! We asked Acorn but they couldn't work out how to do it. Can any readers help?

Dealing with dealers

Sir, I have a problem with my BBC micro and I happened to be chatting with the receptionist of my local dealer. She was puzzled that they were getting BBC micros for repair from areas where there were other dealers. Some addresses implied that people were travelling past their local dealer to get to my one.

Whilst it is very flattering to be so popular the receptionist had the impression that some dealers were charging, or threatening to charge, for work done under warranty. Please can you investigate this because if it is true it causes two problems: people are paying when they should not; my local dealer is swamped with work and hence I have to wait longer for service.

R I Macdonald
Avon

If this is a problem, it's certainly not one we've heard anything about. If you have been charged for work which should have been done under warranty please let us know.

String problems

Sir, I have been trying to create a string file of user defined characters on my Model B microcomputer, but have frequently run into trouble with certain string entries when I have tried to access the file.

Entries in a particular sequence may be accessed, but the same entries in a different order cannot be accessed without the Error Message "Type mismatch" being given. This seems to be a question of where they happen to be relative to the data blocks.

A file of ten entries or less is invariably accessed successfully, but one longer than this runs a severe risk of being rejected. A typical entry is of the type:– "97,0,0,0,0,240,240,240,240" and ten entries are approximately one buffer 'full'.

Could you tell me if this is an operating system fault or if it could be a hardware fault.

H.R. Sanderson
London

I am afraid the fault is because you have the 0.1 operating system and need a 1.0 operating system.

Calculator keypad call

Sir, As a business user of the BBC micro I find that the biggest disadvantage of this otherwise very versatile machine is the lack of a numerical keyboard. . . who will be the first to provide such an attachment?

E. L. Jones
Powys

It certainly would be easier when dealing with a lot of numbers to have the option of a separate numerical keypad. Would any manufacturer out there be good enough to oblige?

Snapping Acorns

Sir, I have a copy of Acornsoft's 'Snapper' program and have so far achieved a score of 145,440. I was surprised to find that after the second bell the 13th sheet was not an Acorn, as stated on the cassette box and in your magazine but another bell!

Also eating a dark blue ghost or being killed in the middle of the tunnel (ie on the very edge of the screen) can leave an image of the pacman on the screen or even crash the program!

Please could you throw some light on these matters.

David Toomb
Nottingham

I am afraid the acorn does not appear until the fourteenth screen! The second problem you mention is due to a bug at the side of the screen which Acornsoft say has been corrected in the latest version. The highest score which we have heard of was 180,000 by someone at Acorn Computers. Has anyone beaten this?



Disc details

Sir, I am considering adding a disk drive system to my BBC model B computer. I am amazed that this will require not only a disk interface but changing the OS EPROM 0.10. Could you please tell me how I can get this changed and how to obtain the disc system?

A.J. Dick
Staff

The disk interface includes the 1.0

continued on page 76 ▶



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Acorn dealers stock and service the Atom computer, Acorn systems and Acornsoft software. Many also offer service facilities for the BBC micro and these are marked with an asterisk. The Acorn dealer not only sells computers and peripherals but provides vital customer support. Most have recently attended technical seminars in Cambridge to ensure that they deal effectively with customers' enquiries. In addition, Acorn supply dealers with specific test and diagnostic equipment to speed fault finding.

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operating system, the 8K disk operating system ROM, the 8271 controller chip and other logic.

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Atom data transfer

Sir, How can you load ATOM data tapes into the BEEB? I have altered the speed with *TAPE3 followed by *LOAD "name" followed by a suitable address. There is no response from the machine, indicating, I suppose, that it has not identified the header.

K.R. Wilkinson
Staffs

Unfortunately the tape format for Atom tapes, is completely different to the format used by BBC tapes, so transfer is not possible. It would be much quicker to take a listing of your Atom programs, and then convert to BBC basic.

Art is interesting

Sir, Ian Smith writes (*Acorn User*, October) 'no doubt people will tell me I'm missing the point when I say that I learnt nothing about the BBC micro when reading Brian Reffin Smith's irrelevant article on art!'

I should indeed like to confirm that he is missing the point. In fact it was the article I enjoyed most in the altogether interesting second issue, and seemed to indicate that the magazine is not going to be devoted narrowly to technical matters alone.

His remarks appear to me highly relevant to computers seen as extensions of the brain (as well as the hand), and to the concept of process as the material of art. These are considerations which led me to acquiring a BBC computer in the first place, and are certainly borne out by experience with it so far.

Probably anyone can get decorative results with the graphics now available, but by ignoring these issues they are likely, as Brian Reffin Smith puts it, to bore everyone rigid who sees them.

John G. Harries
Chichester



Break and print problems

Sir, Could you answer these two questions about the Beeb for me please.

How can one "Break" out of a program to check variables and then return to the program.

How can we control the display of words and numbers when different formats are to be used. In the TRS–80 which uses MICROSOFT BASIC you can use the PRINT USING COMMAND. eg

```
10 A$ ="%  %  ###  ####
#####  %  %"
20 B$ = "FREDERICK"
30 C$ = "SYMBOLIC"
40 A = 1.7592
50 B = 39.4021
60 C = 0.1234567
70 PRINT USING A$; B$,A,B,C,C$
```

This would give on the screen:–

FRED 1.76 39.40 0.1235 SYMBO

I cannot see how to do this on the BBC machine. The @% variable is too cumbersome. Will Acorn implement the PRINT USING statement in future versions of the ROM.

D.V. Long
Kent

I am afraid that you cannot do this because breaking out may corrupt variables, so they get cleared in order to prevent misinformation.

Even though you find this cumbersome, this is the only way. Acorn are not planning to implement a PRINT USING statement in the immediate future.

Procedure parameter problems

Sir, I have used procedures with other languages (subroutines with FORTRAN) and after doing a calculation with the procedure it is normally possible to return the new formal parameters back to the actual parameters in the main program.

For instance in this short program:

```
10 INPUT X,Y
20 IF X>Y PROCswop(X,Y)
30 PRINT X,Y
40 END
50 DEF PROCswop(M,N)
60 LOCAL Temp
70 Temp = M
80 M = N
90 N = Temp
100 PRINT "*", M,N
110 ENDPROC
```

With BBC BASIC it is noticed that whilst the values of M and N are changed over if X is greater than Y, on return to the main program the formal parameters are reset to the values prior to entry into the actual parameter list of the main program. Should this be so?

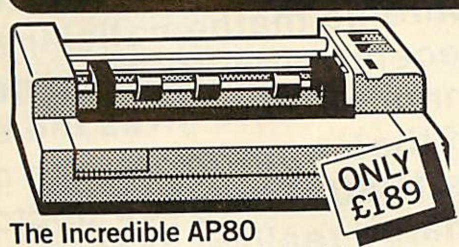
G.F. Clarke
Coventry

BBC BASIC does not implement the return of parameters through the procedure's parameter block but they may be returned through global variables, ie those variables not defined as LOCAL and not in the parameter block.

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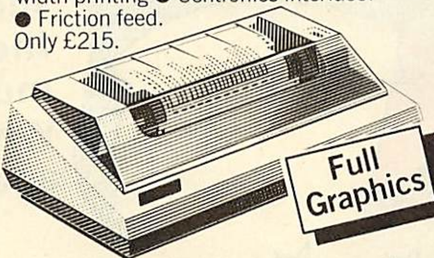
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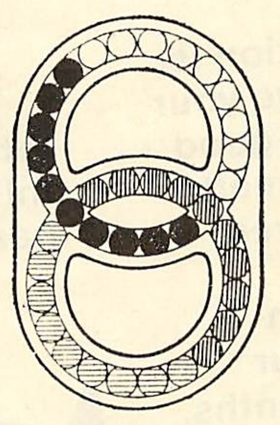
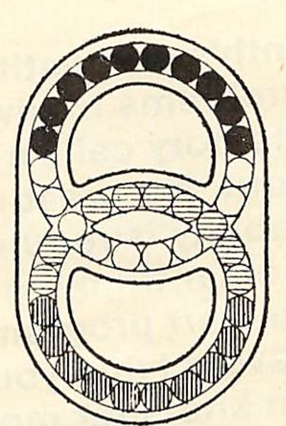
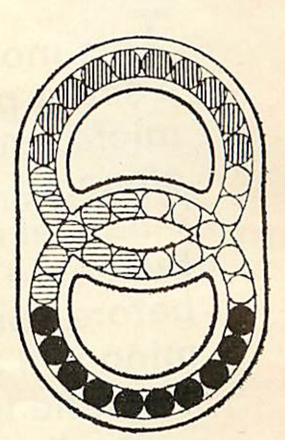
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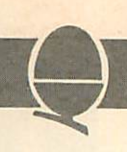
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1 The asylum for schizophrenic mathematicians has recently admitted two new inmates. One gives the sum of their ages as 44, the other as 1280. The good doctor in charge realises that one inmate has subtracted one of the ages from the other while the other inmate has multiplied the two ages. What were their respective ages?

2 Several two digit numbers when multiplied together have the same product when both numbers are reversed. Thus:

12*84 = 21*48
24*63 = 42*36

Which pair of numbers with this particular characteristic has the *highest* product?

This month's competition is a set of problems to give your micro's memory cells a good cleaning out. No great mathematical ability is required, but some clear thinking before you start programming will avoid tying your machine in knots for months.

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3 What is the lower number which is exactly divisible by 32 *different* numbers (including 1 and itself)?

4

Farmer Giles has borrowed £10,000 to spend at market. A sheep costs £500, a goat £300, and piglets only come in lots of three, costing £100 per lot. He wants at least one of each type of animal and must have fewer goats than sheep. How many of each animal must he buy to spend as much as possible?

5

Which 10-digit square (whose exact square root is an integer) has the largest number of nines contained in it?

6

Write down the longest possible list of numbers between one and 50 *inclusive* where no number on the list is divisible by any other number on the list. There are several equal solutions to this. Which list, when its components are added together, provides the lowest total?

Perfect numbers are thus named because they are equal to the sum of all their divisors. The lowest perfect number is 6 because 1+2+3=6. The second is 28 (1+2+4+7+14). What is the third?

8

Find a whole number larger than one digit which, when multiplied by any number between one and nine inclusive, provides another exact multiple of itself if the digits of the result are reversed.

9

Every number can be reduced to a single digit by continually multiplying its individual digits together. The number of steps it takes to do this is variously known as persistence, durability or ply. Take the number 678, for example:

6*7*8 = 336
3*3*6 = 54
5*4 = 20
2*0 = 0

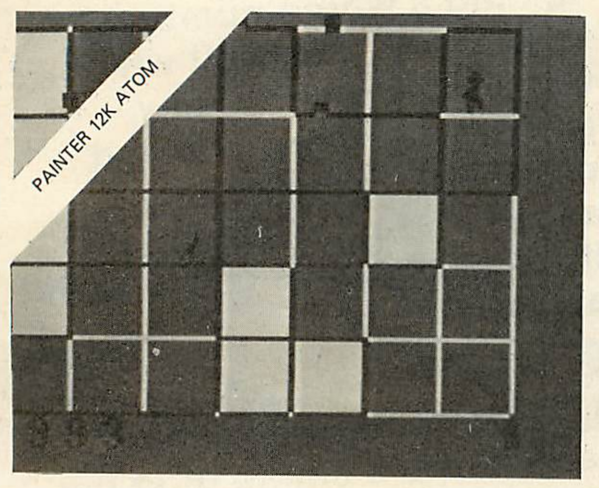
Hence 678 is a four ply number because it takes four steps to reduce it to a single digit. What is the lowest six-ply number?

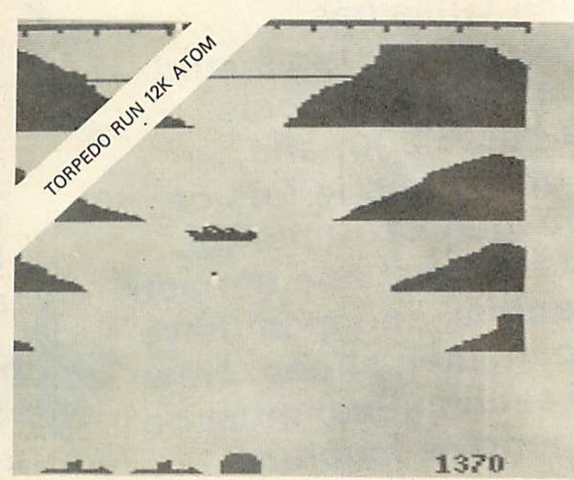
10

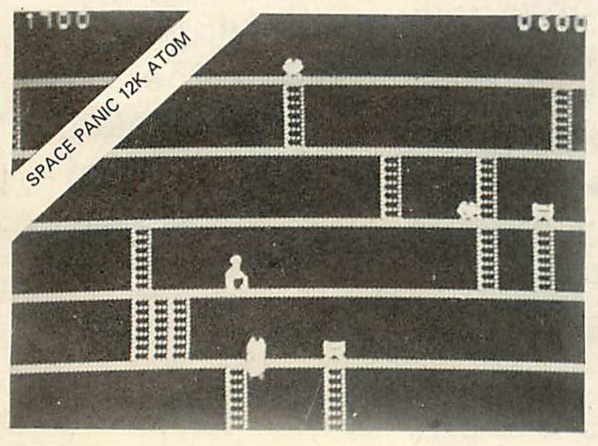
The number 16 is said to be half-one because half the numbers including and preceding it contain the digit one and half don't (excluding 0). Similarly, 2 is both a half-one and a half-two number. The next largest half-two number is 2914. What are the lowest half numbers for the values of 3 to 9 inclusive?

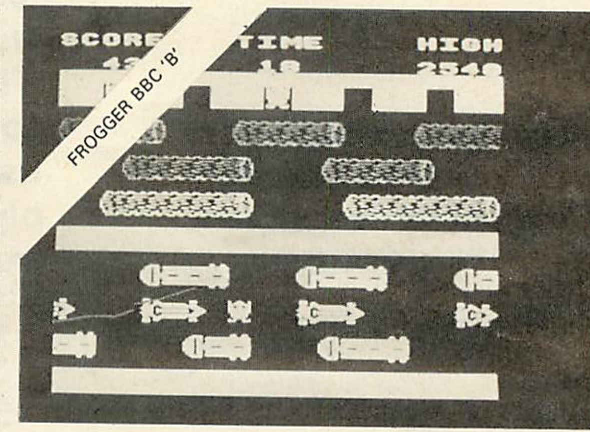
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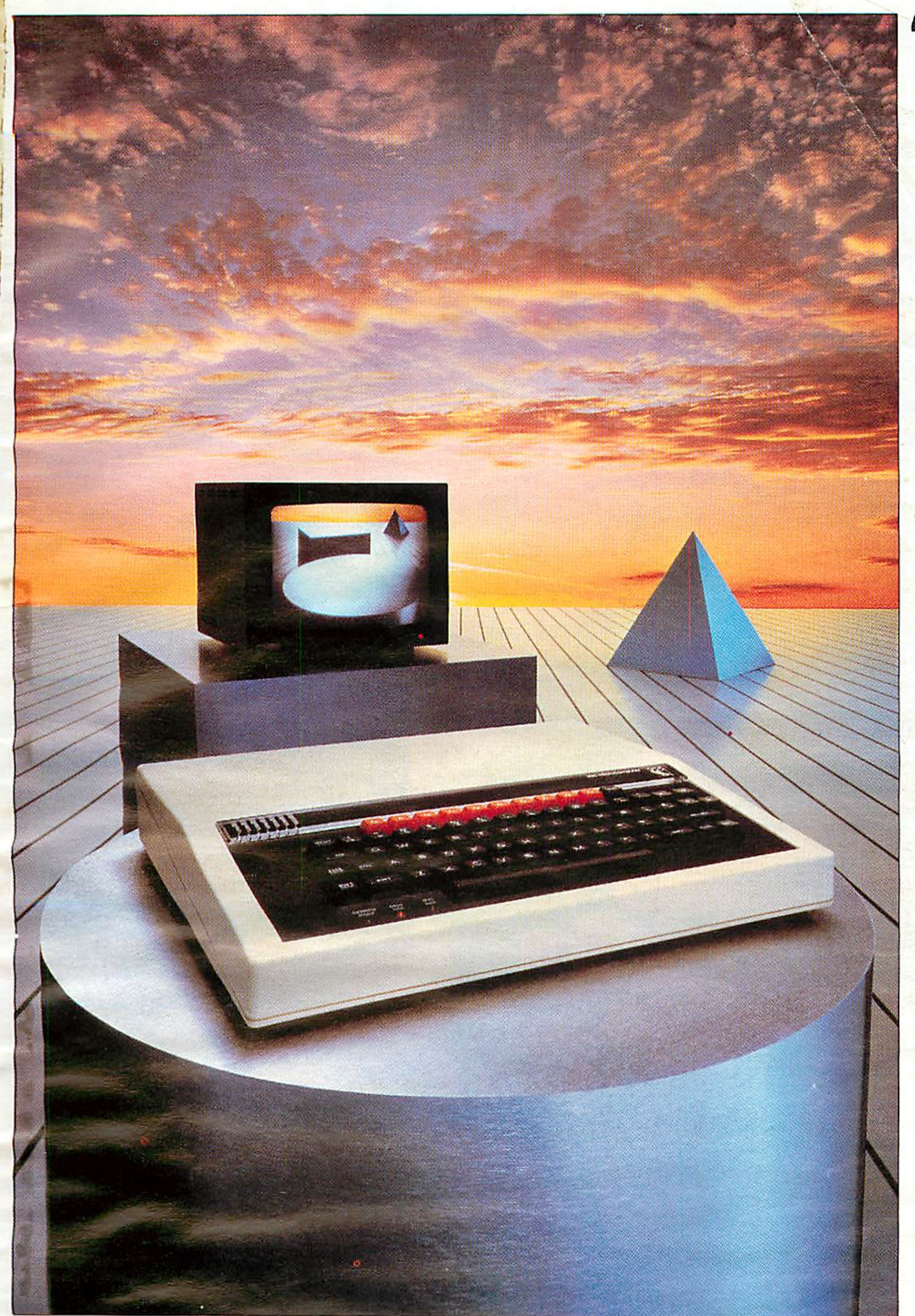
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There are two versions of the computer. Model A, at £299, offers 16K of RAM and Model B at £399 has 32K of RAM.

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